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ENGINEERING • CONSTRUCTION • OPERATIONS

PIPE LINE INDUSTRY

FEBRUARY
1961

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an example of the tough, API quality pipe
Joe Roughneck expects . . and gets . .
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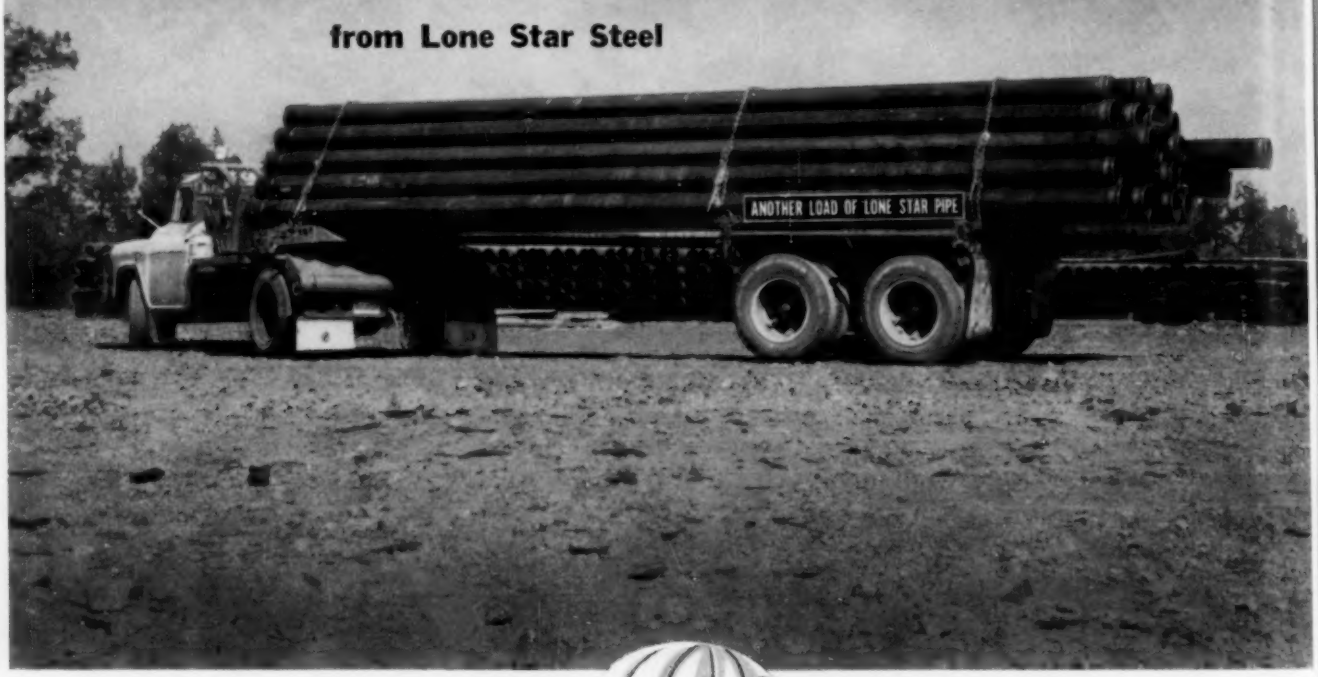

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PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

February 1961 Vol. 14, No. 2

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Designing Compressor Foundations for Sandy Soils

☐ Static loading of compressor foundations is accomplished by vibration; this can cause settling in sandy soils and lead to excessive stresses in pressure piping. Knowledge of soil characteristics, effect of loading, vibration and settlement action will help you to minimize this hazard in station design. Tests and design examples are given in simplified engineering terms.

By R. E. Means.....Page 26

Magnetic Particle Inspection at Regular Intervals Can Prevent Major Troubles

☐ Even very small fatigue cracks will show up in fluorescent magnetic particle inspection, if the technique is used correctly. Here are methods of inspecting critical engine and compressor parts.

By Sam Vance.....Page 30

The Low First Costs and Many Benefits of Ebullient Cooling

☐ Most companies using this system are finding many advantages over conventional equipment. Lubrication is better, wear less, thermal efficiency is higher in some cases and initial costs are often less.

By H. W. Evans.....Page 33

Analysis of Frozen Stresses Will Bring Better Valves, Piping

☐ By making a plastic model of a complex part, heating it to a critical temperature, then stressing it and allowing it to cool under stress, the stresses will be frozen in the part. Once the freezing has been accomplished, the unit can be examined under polarized light to find stress concentrations. Also, the model can be sliced up for detailed analysis.

By F. C. Monkman and A. C. Thompson.....Page 37

New and Unusual Ideas in Mobile Radio

☐ Here are some of the new ideas: base station operation through PBX; intercom and radio combined; economy style weatherproof base station; handy talkie with loud speaker; transistorized amplifier for external loud speaker; emergency power supply for remote consoles, and "poor boy" remote control console.

By J. O. Mostrom.....Page 41

Computer Dispatching for Gas Systems Is Coming

☐ Several groups have made studies which indicate this step is practical. Developments in the past few years made remote measurements and telemetering readily available; we now have field computers that convert differential and static pressures, temperatures and other factors into flow.

By R. E. Burrell.....Page 47

So You Have to Make a Speech

☐ Quite often those who are faced with the prospect of having to make a speech are in a dilemma because they just don't know how to put it across. If you're ever in that situation, here are some suggestions that will pull you through with flying colors.

By Ernest W. Fair.....Page 57

REGULAR MONTHLY DEPARTMENTS

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PIPE LINE INDUSTRY published every month. Second class postage paid at Houston, Texas © Gulf Publishing Company 1961

Memo to: Subscribers

Why PLI circulation jumped 82 percent in six years!

Your acceptance of PIPE LINE INDUSTRY's leadership in reader service and editorial quality has made it possible to make this report—The December 1960 circulation statement submitted to the Audit Bureau of Circulations shows PIPE LINE INDUSTRY has 6,164 subscribers—*more than any other publication specialized for the pipe line construction, engineering and operations phases of the oil and gas industry.*

Here are five reasons why PIPE LINE INDUSTRY has followed the industry's growth:

• Editorial Tailored to the Readers' Needs

PLI's editorial program is geared to the men most interested in keeping abreast of technical developments —who have the greatest influence in the selection of pipe line equipment.

Articles are presented with sufficient detail to fill the reader's needs. For example, a chief engineer with a major gas transmission company reported that an article on batching two phase flow from the March (1960) PLI was so complete that his engineers were able to use it to design a similar system for their own company. Another series on offshore pipe line construction was used by a leading marine gas pipe line company as a basis for the design of offshore lines. An article on leak location during hydrostatic testing led to the formation of a company to carry out this service on a contract basis.

• Leader in New Ideas

Here are some of the editorial "firsts" from 1960 PLI's:

How to batch two-phase flow with spheroids—Innovations used in Transwestern's pipe line—A pump station that operates unattended without communications—How to design railroad and highway pipe line crossings—Solving leak problems with nitrous oxide and infrared detectors—These are just a few of the new ideas which prompted requests for more than 30,000 reprints of PLI articles last year!

• Balanced Article Selection

Much of PIPE LINE INDUSTRY's editorial success stems from a strict screening plan that permits only the most informative, complete and accurate articles to appear in the magazine. The field-experienced editorial staff handles hundreds of articles each year. Only the most outstanding pass the tests for publication.

• Most Accurate Statistical Reports Available

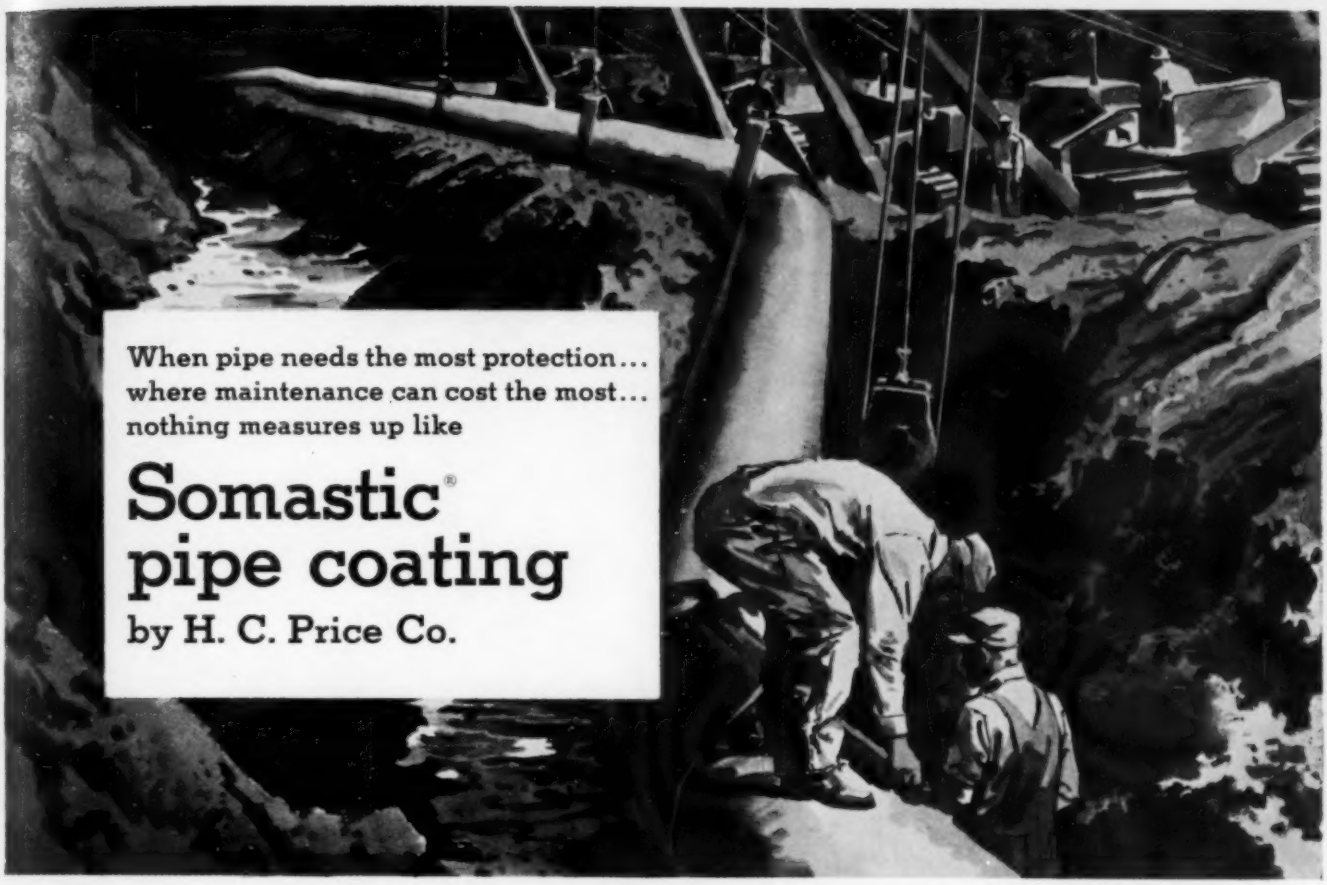
PLI is second to none in this department. In January 1959, PLI forecast 16,631 miles of U.S. pipe line construction for the year. The actual total was 16,277 miles, for a 98 percent accuracy mark. Last year, 17,683 were predicted. The final total was 18,610 miles, for a 95 percent accuracy mark.

PLI's monthly construction reports, market and statistical reports are regarded as the most complete and accurate published for the industry.

• More Attractive, Readable Format

The editorial and layout staff are constantly seeking new ways to improve the appearance of PLI. During recent months several improvements, have been made in type faces, monthly departments, and in the layout of articles. The new feature "Ideas for the Future" has become one of the magazine's most popular features.

The results are reflected in PLI's growing circulation, reprint sales, plus written and verbal comments from a large number of subscribers.



When pipe needs the most protection... where maintenance can cost the most... nothing measures up like

Somastic® pipe coating

by H. C. Price Co.

Today, in the swamplands . . . in highly corrosive soils . . . in seawater itself . . . SOMASTIC® gets the call from the nation's pipeline men. They *know*, from scientific examinations made of SOMASTIC®-coated lines that have been operational as much as 30 years, that this asphalt-mastic coating keeps on protecting against corrosion long after other coatings have developed costly holidays.

EXAMPLES: 10″ and 8″ product line running 115 miles through the waters and muck of the Louisiana swamps, in operation over 18 years; a 25-mile, 14″ line laid deep in the bottoms of Lake Pontchartrain, now in its 19th year; 335 miles of 6⅝″ pipe from Kansas to South Dakota, now in its 20th year. (Details on request.) These are but three examples of the scores of pipelines, totaling thousands of miles, that have been protected against corrosion by SOMASTIC® pipe coating.

How about the economics? Today, the H. C. Price Co. Pipe Coating Division offers SOMASTIC® pipe coating at prices sharply competitive with enamel wraps or other coatings. Low initial cost combines with predictable low maintenance costs for the most favorable pipe coating economics available. Because of its greater weight, SOMASTIC® offers considerable savings where weight is a factor, such as in marine or swamp installations.

Want the proof? Substantial material is available on periodic examinations of SOMASTIC®-coated pipe. Mail the coupon below for reprints for your file, plus the newly issued book on SOMASTIC® use and specifications. No obligation, of course. Information is also available on HEVICOTE® concrete coating, including weight and displacement tables.

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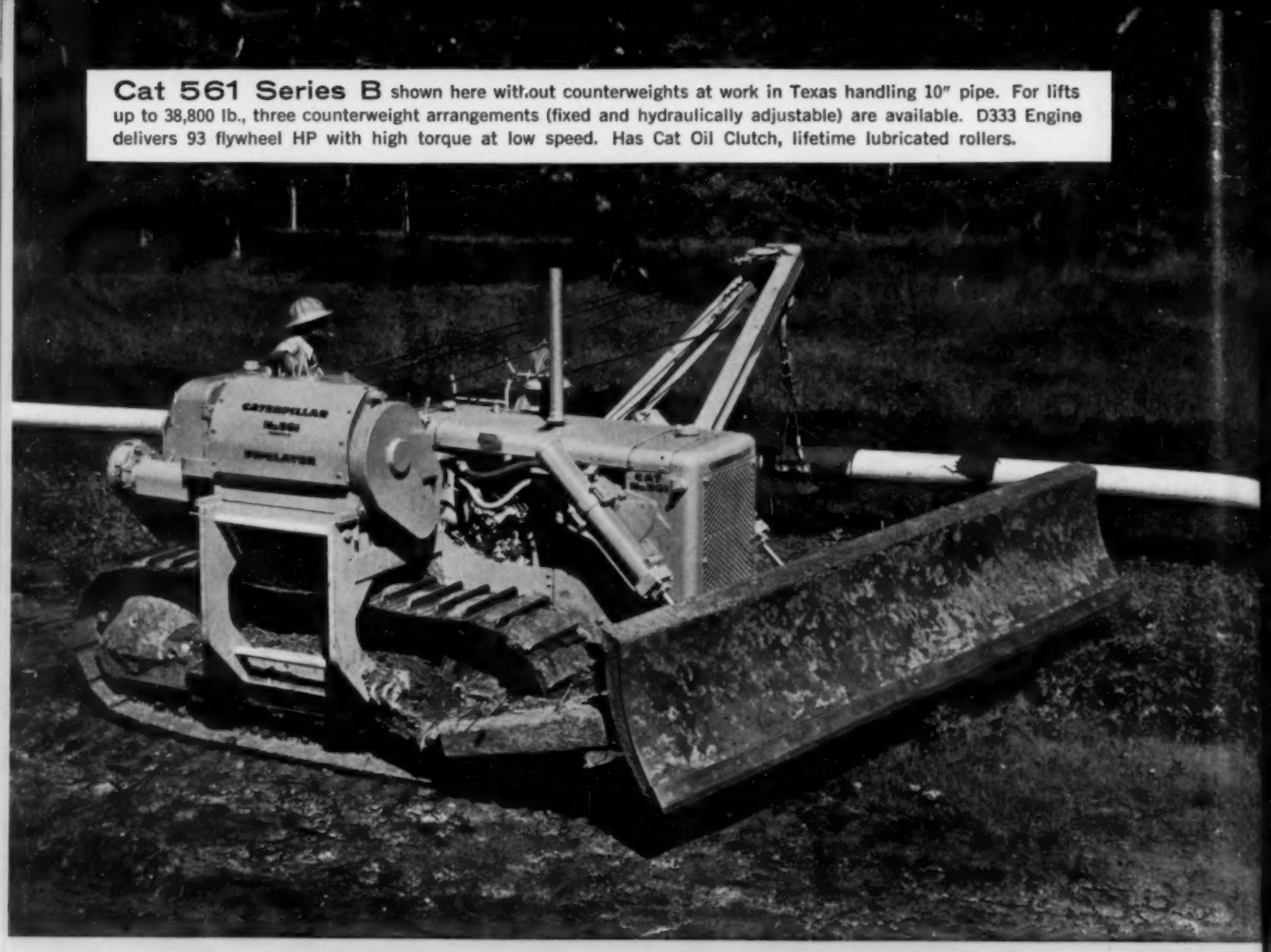

Cat 561 Series B shown here without counterweights at work in Texas handling 10" pipe. For lifts up to 38,800 lb., three counterweight arrangements (fixed and hydraulically adjustable) are available. D333 Engine delivers 93 flywheel HP with high torque at low speed. Has Cat Oil Clutch, lifetime lubricated rollers.

MD7 AND 561 PIPELAYERS

...Caterpillar makes 'em

TAKE THE CAT 561 PIPELAYER—G. W. Townsend Lease Service (Bay City, Texas) used a 561 to lay four miles of 10" and 12" natural gas line for Pan American Petroleum Corp. near Sweeny, Texas. In open country, 600' of pipe was lowered into a 48" by 24" ditch in two hours. In close quarters, an average of 2000' of pipe was lowered in daily.

What do the Townsend people think of the 561? They like the way it handles. They like its balance and the way it responds—fast and accurately. The operator singled out the placement of controls. They're in easy reach, without stretching. Their location permitted him to keep his eyes on the work as he moved along the ditch.

With an angle filler up front, Townsend's 561 takes on extra jobs—backfilling and other utility work. (Another contractor put a No. 6A blade on his 561, uses it for right-of-way clearing. The 561's integral hydraulic system—optional—makes it easy to handle a blade, keeps pump and valves under the hood out of the way.)

All in all, the 561 does the kind of job you expect of Cat Pipelayers. *Dependable*—work done quickly and economically.

OR TAKE THE MD7—Ford, Bacon & Davis Construction Corp., Monroe, La., had about 30 miles of 12" pipe to lay south of Welsh, La., for

Cat MD7 is shown cradling pipe in Louisiana marshland. The Series D MD7 has greater power (140 flywheel HP and 54,200 lb. lifting capacity), improved torque rise (boosts lugging ability by 80%), and there's a new dry-type air cleaner, new, stronger final drives, and many other advantages to boost production and lower costs.

to make money for you

the Louisiana Pipeline Company. The route met an average of three irrigation canals per mile, in addition to Louisiana bayous and swamps. Even so, with three new Cat MD7 Pipelayers in the spread, 4000′ to 5000′ were laid every day.

The MD7's seven-roller track frame and 22″ track shoes give the new Cat Pipelayer exceptional stability and flotation needed in swamps and bayous. No wonder, then, that Ford, Bacon & Davis are pleased with the performance of the new MD7s. They bought them for high production under tough conditions. And that's what they're getting.

These new Cat Pipelayers have what it takes to turn in performance records even better than previous models. Extra production slashes operating and maintenance costs . . . see your Caterpillar Dealer for the whole story on the new pipelayers. Ask for an on-the-job demonstration.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

CATERPILLAR

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- TESTING
- INSTALLATION

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Chance application engineers will conduct soil test probes (photos A & B) to determine where anchors should be installed, the size anchors needed, and the proper anchoring depth. Pull tests (photo C) will verify their recommendations. Then, for a reasonable fee, Chance will provide special installation equipment, and the services of an installation supervisor.

Here's one job you can leave to *Chance!* You'll save money, too, because Chance Anchors cost much less than counter weights. And, they're lighter and less bulky than counter weights ... cheaper to transport, easier to store. A complete unit (two anchors and one bracket) weighs from 29 to 180 pounds, and will hold 5,000 to 30,000 pounds.

Call or write for complete information on the Chance Field Service Plan.

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Phone: CApitol 8-2777

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PIPE LINE INDUSTRY and The PIPE LINE CATALOG for the oil and gas pipe line industry.

WORLD OIL (formerly the Oil Weekly) and The COMPOSITE CATALOG for the drilling-producing industry.

PETROLEUM REFINER and the REFINERY CATALOG for the Hydrocarbon Processing Industry.

Indexed by Engineering Index

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A MATTER OF CONTROL

In the Orient the cormorant industriously catches as many fish as it can. But its masters put a ring around its neck to prevent it eating what it catches. It's a matter of control. Yet you can be sure the master gives the cormorant enough fish to sustain healthy life and growth. Some for the master; some for the cormorant. Otherwise, no fish for anyone!

Under federal regulation we have, within 16 years, brought natural gas by pipeline to distributing systems serving 24 states with a population of 118 million. Given enlightened regulation in the future, we will continue to better and enlarge this public service.

TENNESSEE GAS TRANSMISSION COMPANY

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NEW ENGINEERED TEFLON PISTON RINGS

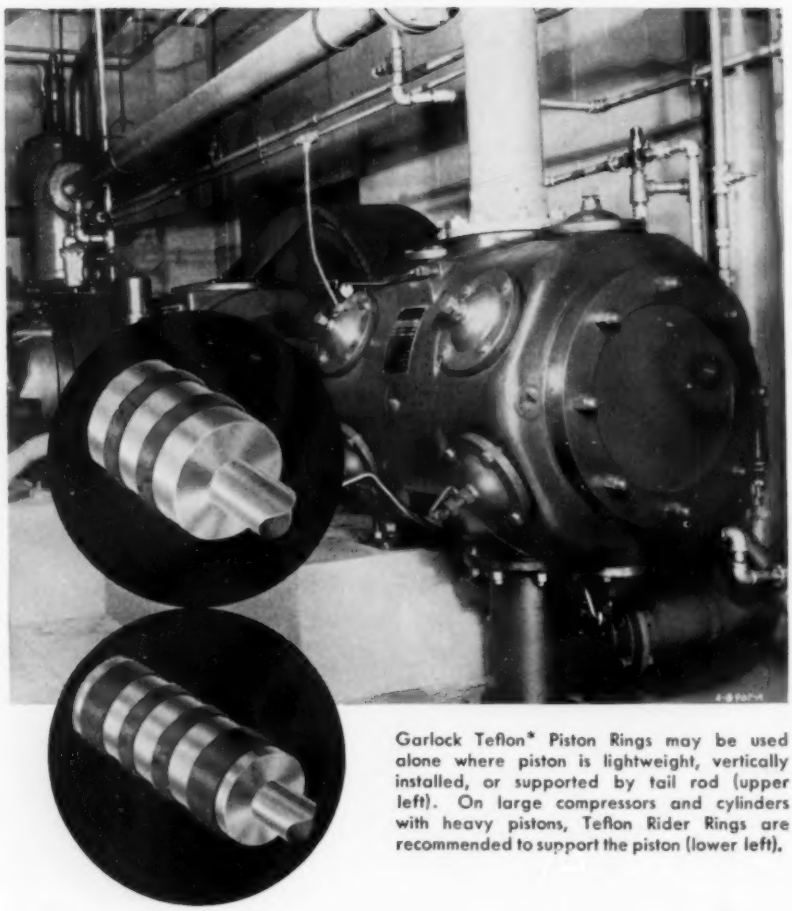
for Non-Lubricated Service

Time after time, Teflon Piston and Rider Rings—the newest of Garlock products—prove effective in extending ring life under non-lubricated or chemical service.

A compressor used in wet hydrogen service was fitted with six rings of Teflon. Lubrication was eliminated and the rings were still in service after 2000 hours. Cast iron piston rings previously used needed lubrication and lasted less than 100 hours.

Another compressor operated at +350°F to supply instrument air. With Teflon Piston Rings, the compressor has been in continuous service for over 2500 hours without lubrication; the radial wear rate is approximately .009 per 1000 hours. Before this, the cylinder had to be lubricated; it was also necessary to periodically remove oil from the discharge air to prevent entry into instrument air lines.

The first really satisfactory piston rings for non-lubricated service, Garlock Teflon Piston and Rider Rings are engineered for longer life and better heat dissipation. They have the lowest coefficient of friction of all materials, are chemically inert, and will not contaminate the gas or fluid in the system. Garlock Teflon Piston and Rider Rings will not crack or break, will not score cylinder walls, and are flexible for easy installation. They can be applied at temperatures from −420°F to +500°F, are available in carbon-graphite filled Teflon or glass-filled Teflon, and come in either butt joint, step joint, scarf cut or solid, depending on your needs.



Garlock Teflon* Piston Rings may be used alone where piston is lightweight, vertically installed, or supported by tail rod (upper left). On large compressors and cylinders with heavy pistons, Teflon Rider Rings are recommended to support the piston (lower left).

Talk to your Garlock representative about Teflon Piston and Rider Rings. He is backed by years and years of experience in the design, manufacture and application of packings and seals of all types. You will find him in your locale at the nearest of the 26 Garlock sales offices throughout the U.S. and Canada. Or, write for Catalog AD-178. Garlock Inc., Palmyra, New York.

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Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products.

*DuPont Trademark

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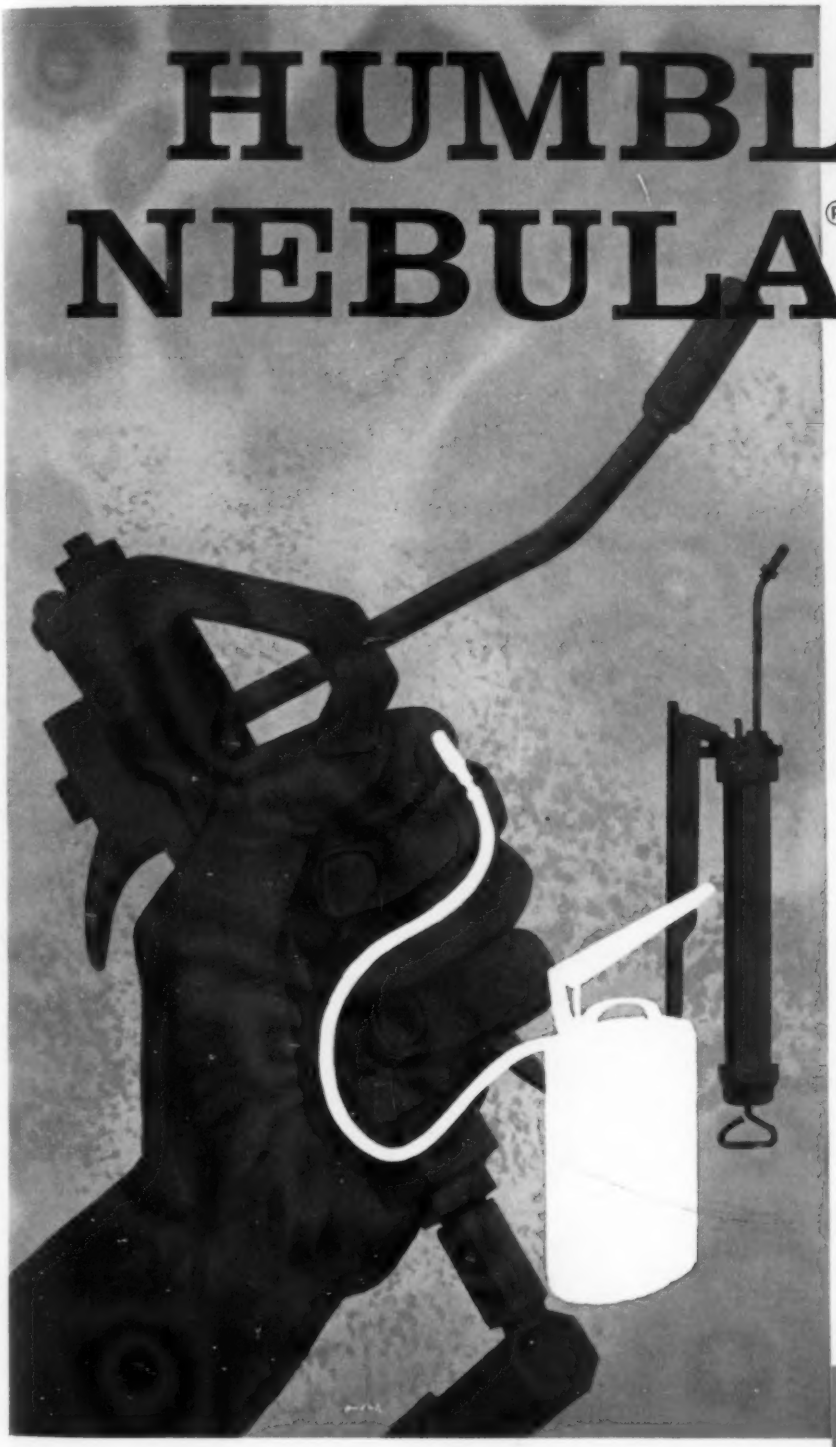


Now you can buy a *multi-use* grease that generally outperforms most *special purpose* greases! Humble NEBULA EP-1 is especially developed for tough jobs — where heat, water, oxidation or heavy loads have previously limited the use of a multi-use grease. The unique formula of NEBULA EP-1 gives superior equipment protection . . . with all the economies you expect from multi-use grease. Order NEBULA EP-1 from your nearest Humble bulk plant, or call Humble Oil & Refining Company, Houston, Texas.

NEBULA EP-1 offers these economies:

- *One* grease bought in quantity — at quantity discounts.
- Reduced inventory and handling
- The *right* grease always handy

America's Leading ENergy COmpany

HUMBLE

Save on oil exploration and production costs with '61 FORD TRUCKS

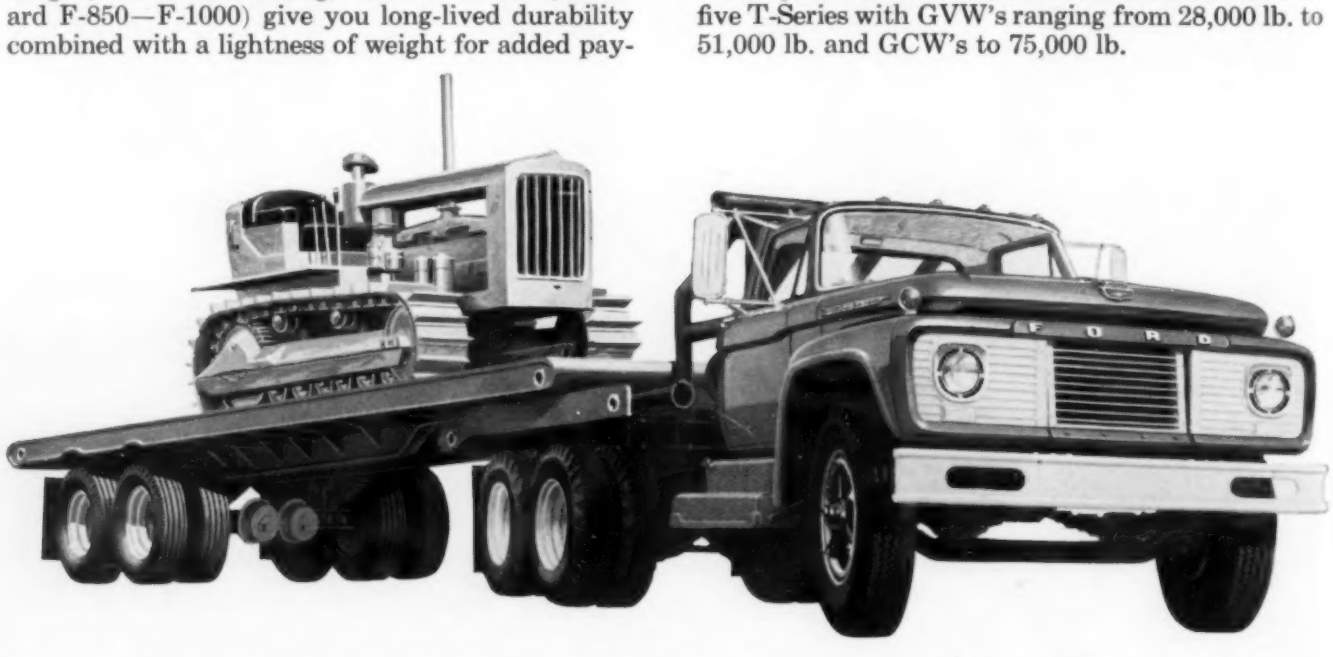
NEW SUPER DUTIES CUT OPERATING COSTS, GIVE PROVEN DURABILITY THAT'S BACKED BY A 100,000-MILE ENGINE WARRANTY

New 100,000-mile warranty on Super Duty V-8 gas engines is the most liberal in the industry. On 401-, 477- and 534-cu. in. V-8's, Ford Dealers will replace any major engine part (including block, heads, crankshaft, bearings, valves, pistons, rings) found to be defective in materials and workmanship providing trucks are used in normal service. The warranty covers full cost of replacement parts for 100,000 miles or 24 months, whichever occurs first . . . full labor costs for first year or 50,000 miles, sliding percentage scale thereafter. Never before have you had such protection . . . such evidence of long term durability!

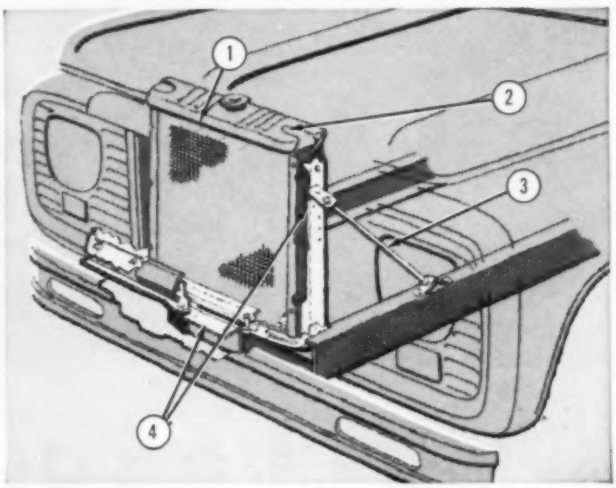
And you save with greater gas economy! Certified tests prove the new Super Duty V-8's give up to 20% better mileage. In addition, Ford's new lightweight, *extra hi-tensile* single-channel frames (standard F-850—F-1000) give you long-lived durability combined with a lightness of weight for added payloads. All in all, you get proven components and design features . . . in trucks built for easier maintenance and lower running costs.

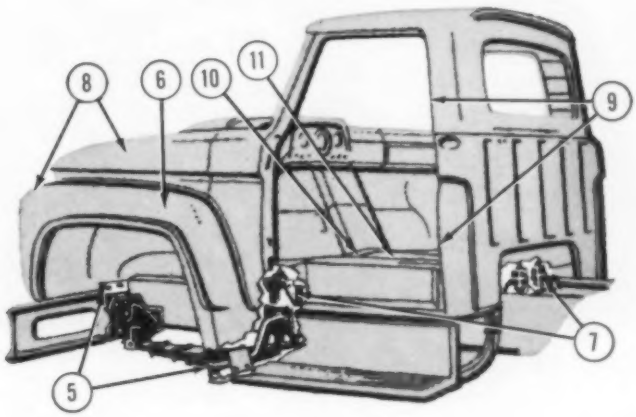
Save with Ford T-Series Super Duty Tandems for exceptional durability, big payloads and low operating expenses. Ford T-850 and T-950 Tandems with Super Duty V-8 engines have rugged double-channel, hi-tensile frames for maximum strength, minimum weight. And they provide a wider range of chassis options so you can choose the right power train and load-carrying components for any job. Eaton and Timken rear axles are now available in bogie assemblies with up to 38,000-lb. capacity. And lightweight aluminum walking beams, wheels and gas tanks are available to keep chassis weights low . . . payloads high.

Ask your dealer about Ford's full tandem line... five T-Series with GVW's ranging from 28,000 lb. to 51,000 lb. and GCW's to 75,000 lb.



SAVE WITH NEW HEAVY-DUTY CONSTRUCTION THAT DOUBLES CAB, SHEET METAL AND RADIATOR LIFE





(1) **Save with Ford's exclusive "lock-seam" radiator construction** that doubles the solder area at key seams for greatly increased strength and longer radiator life.

(2) **Save with heavier-gauge metal on radiator tank and header.** Upper and lower tanks and header have thicker walls to resist vibration, jolts and corrosion for greater reliability.

(3) **Save with independent radiator mountings,** separate from front-end sheet metal. This means that road shocks, vibrations and shakes are not transmitted to the radiator through sheet metal . . . tanks, tubes and connections last longer, require less maintenance.

(4) **Save with "horse collar" mounting** seated on rubber pad for extended radiator life. This new mounting on resilient rubber at the center of frame cross member soaks up any frame flexing . . . cuts wear and tear on entire cooling system.

(5) **Save with independent fender mountings.** Fenders are bolted to a rubber-cushioned transverse bracket at the front and a frame-mounted bracket at the rear. This mounting, independent of both cab and radiator, eliminates stress transfers for greatly increased fender life.

(6) **Save with removable fenders.** The quick and easy removal of only 8 bolts per fender provides faster service accessibility to the engine area, saving valuable maintenance time.

(7) **Save with new 3-point cab mounting system** for greater cab durability. Two outboard front mounts plus a centered "twin" rear mount provide a triangular system that holds the cab stationary while allowing the frame to move independently . . . reducing strain on the cab.

(8) **Save with 42% heavier-gauge sheet metal** in fenders, hood, cab floor pan and toeboard for greater strength, greater durability.

(9) **Save with stronger cab construction.** New full-length door pillar reinforcements provide increased cab rigidity, stamina.

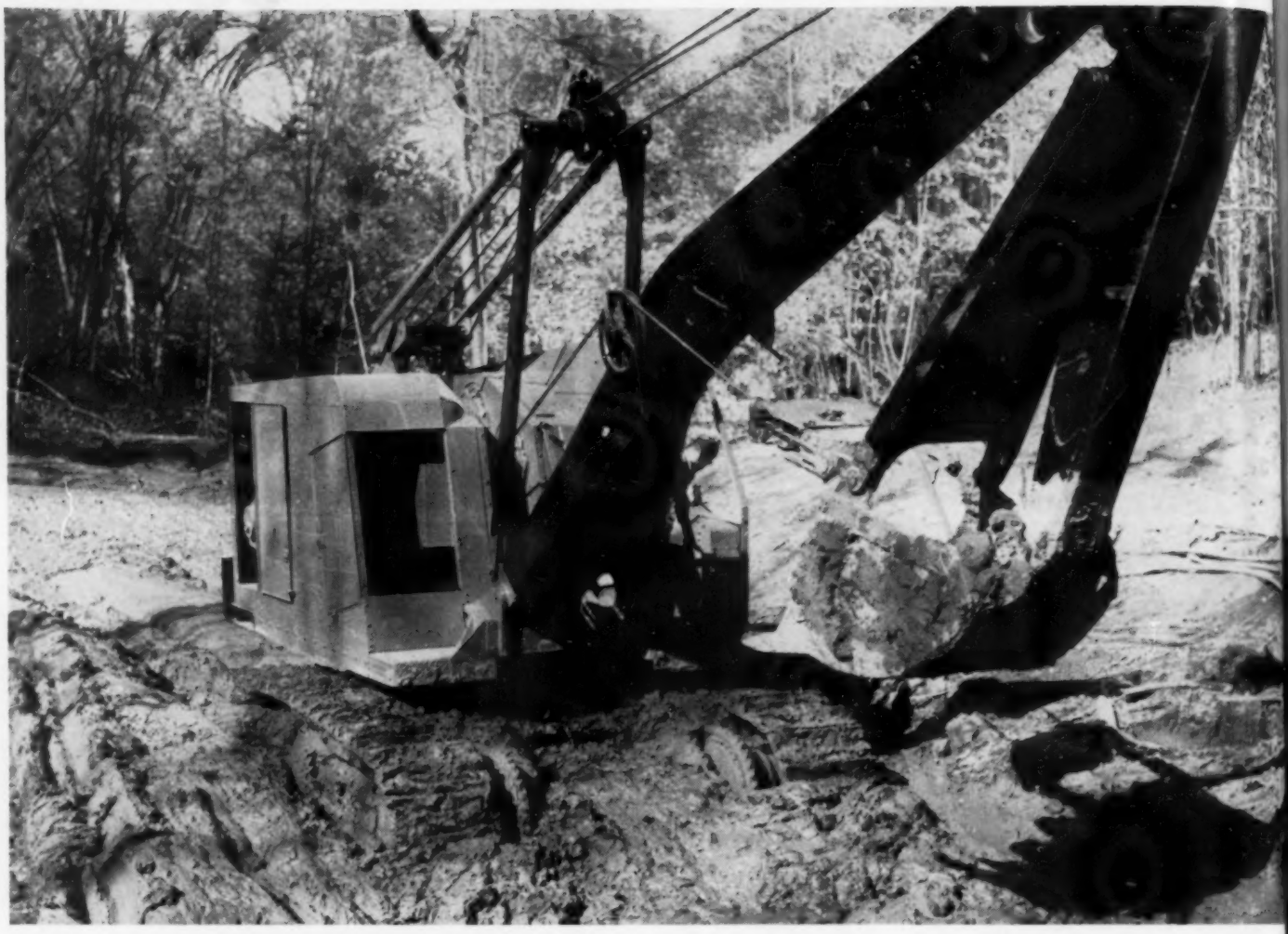
(10) **Save with a more solid foundation.** 42% thicker sheet metal is used in the integral floor pan and toeboard, this with added floor reinforcements gives a stronger base for longer cab life.

(11) **Save with new transmission access panel** to cut transmission service time.

FORD TRUCKS COST LESS

YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" PROVES IT FOR SURE...

FORD DIVISION, *Ford Motor Company*



FROM LINK-BELT SPEEDER . . .

New tractor lower for 3/4-yd. *pipeline punishment mile*

The ability to go anywhere . . . and to keep going mile after mile through hardpan, shale, sand, dirt or muck. This calls for a real pipeline rig — no ordinary machine, certainly!

Link-Belt Speeder's ¾-yd. LS-78 with all-new tractor-type lower (optional) represents a considerable departure from conventional hoe-dragline-clam design. That's why it steps ahead with maximum traction and extensive travel, with two speeds forward or reverse.

A TRUE PIPELINE LOWER! Tractor-type track belt has full-width grouser shoes for bite on the tough stretches. And the track belt clears itself of stones and branches, thanks to the specially engineered compensating idler system. The LS-78 can't walk out of its tracks, either.

Simple built-in track adjustment. All you need is a grease gun.

COMPLETELY SEALED LOWER FRAME. The traction and power-steer mechanism is fully protected while traveling in deep water or muck. On solid ground, the extra-high, 22-in. clearance enables the pipeline lower to skim over pesky snags. Hydraulic control lines under the upper are covered with heavy-gauge sheet metal.

DESIGNED FOR THE STEEPEST GRADES. A higher oil level in the deck gear compartment, plus the deeper oil pan under the engine, assures proper lubrication on steep inclines. Three-way adjustable operator's seat features a **quick-release** safety belt.

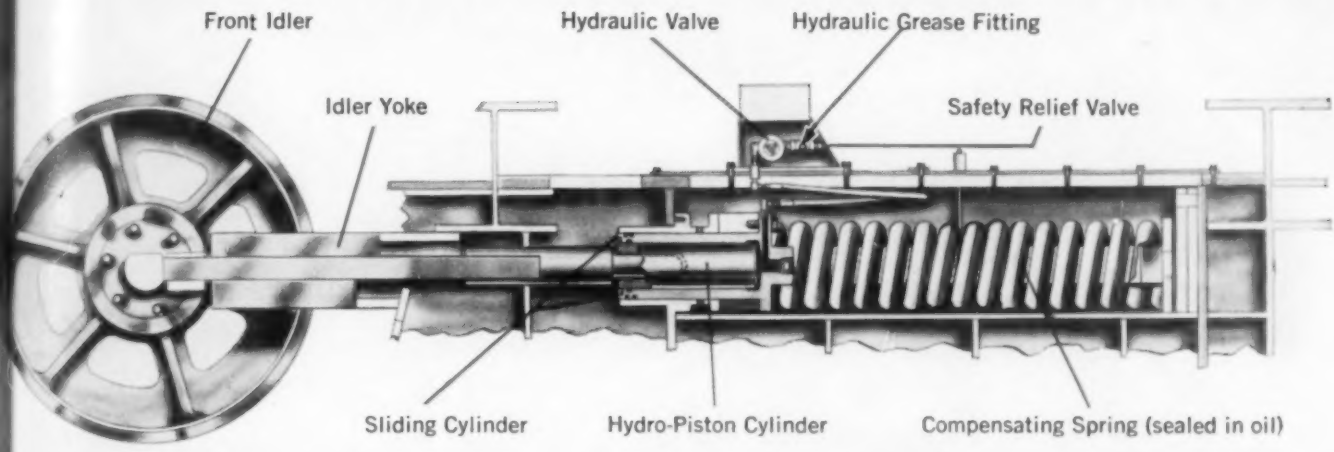
PIPELINING'S MOST VERSATILE UPPER. The LS-78 upper is Full-Function-Designed for *totally unrestricted* operation: Each machine function is completely independent. Available are power load-lowering clutches for either or both main drums, third drum, and independent-swing-and-travel, which eliminates shifting, saves time on every cycle.

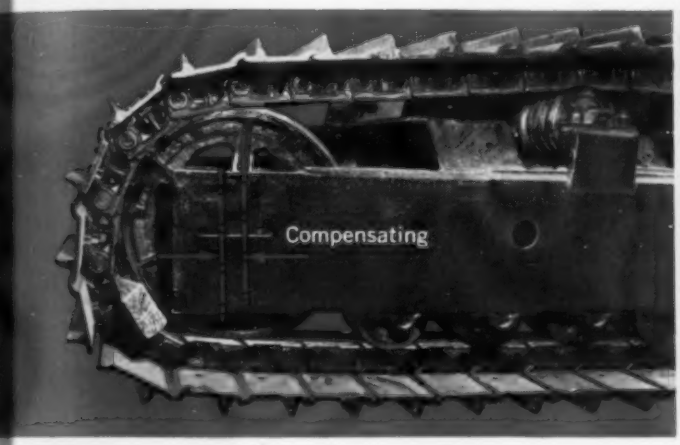
SPEED-O-MATIC CONTROLS KEEP OPERATOR FRESH. Smooth, instantly responsive, true power-hydraulic controls actuate all clutches. No jump, jerk or lag . . . every job safer. Split control stand affords better below-grade vision.

See your Link-Belt Speeder distributor for complete details on this remarkable "work and travel" rig. Or write for the fully illustrated 24-page LS-78 catalog (No. 2776). Link-Belt Speeder Corporation, Cedar Rapids, Iowa.

120-60N

COMPONENTS OF THE UNIQUE COMPENSATING IDLER SYSTEM . . .



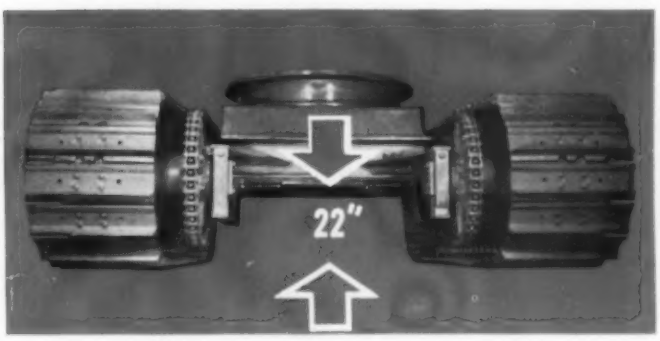


Track adjustment is simple and quick, accomplished through a built-in hydro-piston which is actuated by a grease gun **(above).** Preset safety valve prevents overtightening of tracks.

Unique track compensating unit relieves excessive track tension caused by obstructions that may wedge between the track rail and idler wheel or drive sprocket **(above left).** Powerful, single spring is enclosed in oil and the entire compensating mechanism is designed to prevent cocking of the idler wheel.

LS-78 takes *after mile!*

Wide-stance lower features extra-high, 22-in. ground clearance . . . clean, flat underbody. Completely sealed to protect bevel gears, steer clutches, digging brakes and all components of the traction mechanism.



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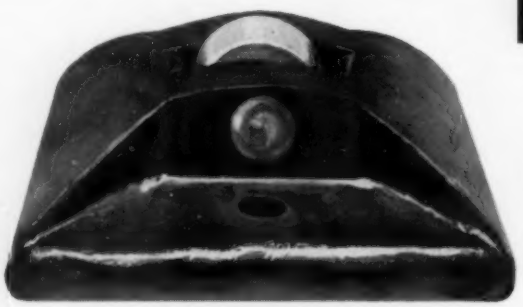
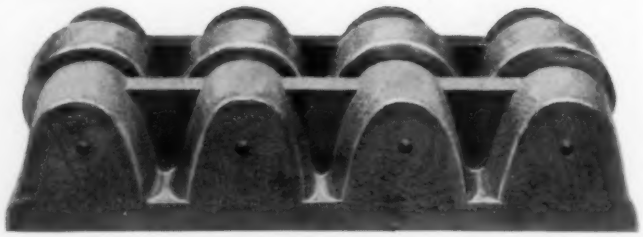


Patent Pending

Single Greenhead "Go-Roll" staggered on neoprene backed metal band for pipe over 20"



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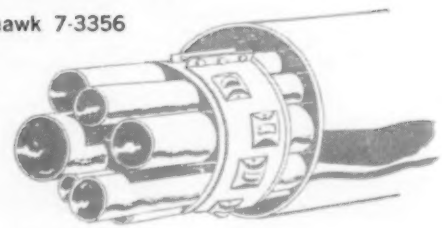

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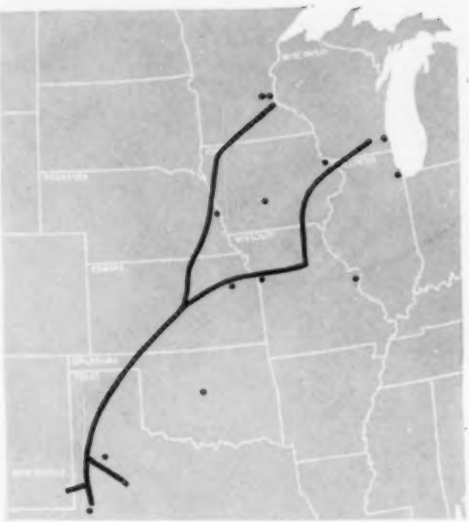
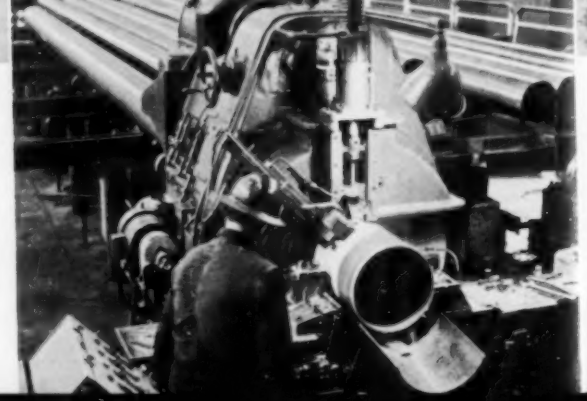
Bethlehem Line Pipe Performs for Mid-America Pipeline



For this 2,200-mile LPG pipeline, Bethlehem furnished some of the longest line pipe on record. Lengths of the 8-in., X52-Grade pipe reached to 62 feet! That's mighty long pipe. And every inch of it is top-quality . . . the kind that keeps pipeliners moving at top speed.

▲ *In a Kansas field, Bethlehem pipe waits for the stringers. Extra-long lengths, squared ends, and accurate bevels mean fewer and faster welds, smooth installation.*



Bethlehem Electric Resistance-Weld line pipe *is produced on modern facilities at our Sparrows Point, Md., plant in sizes from 5-9/16- to 16-in., OD, in lengths to 62 ft.* ▶

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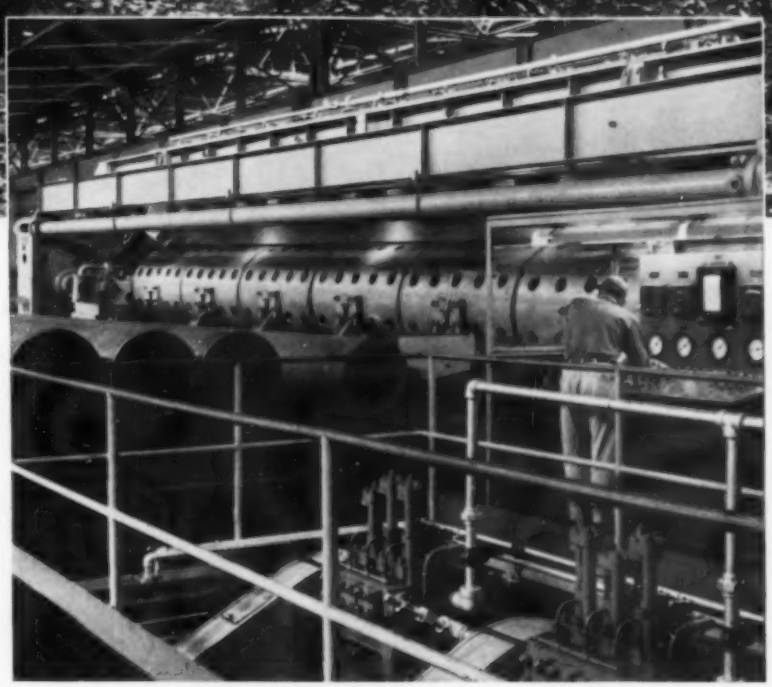

Electric Fusion-Weld line pipe *facilities, newly-installed at Bethlehem's Steelton, Pa., plant, turn out pipe from 18 through 42-in., OD, with walls to 3/4-in. in all diameters.*

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BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

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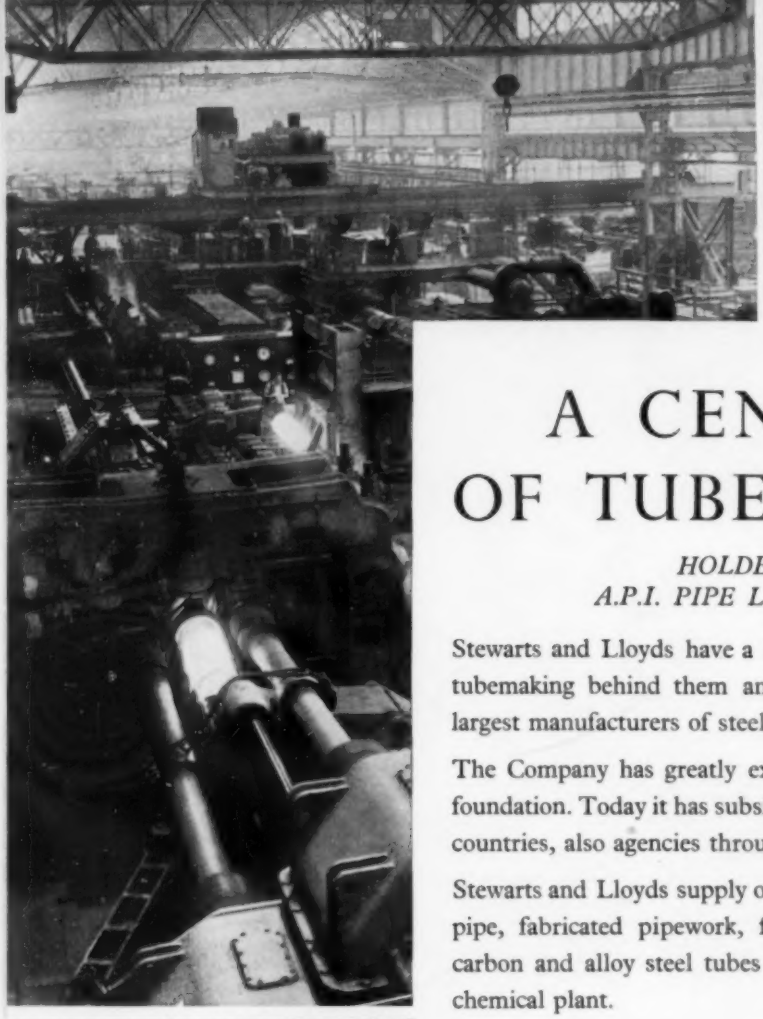

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Stewarts and Lloyds have a hundred years' experience of tubemaking behind them and they are now one of the largest manufacturers of steel tubes in the world.

The Company has greatly extended its interests since its foundation. Today it has subsidiaries and associates in many countries, also agencies throughout the world.

Stewarts and Lloyds supply oil well casing and tubing, line pipe, fabricated pipework, fittings and various types of carbon and alloy steel tubes required for oil refinery and chemical plant.

Stewarts and Lloyds were the first manufacturers to be licensed by the American Petroleum Institute to apply the A.P.I. monogram to their oil country tubular goods.

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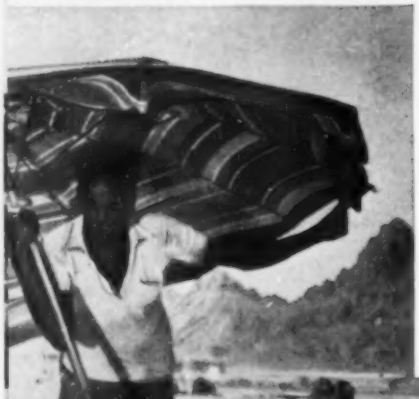

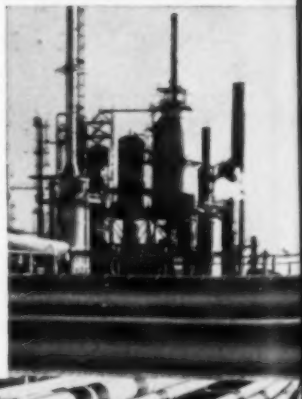

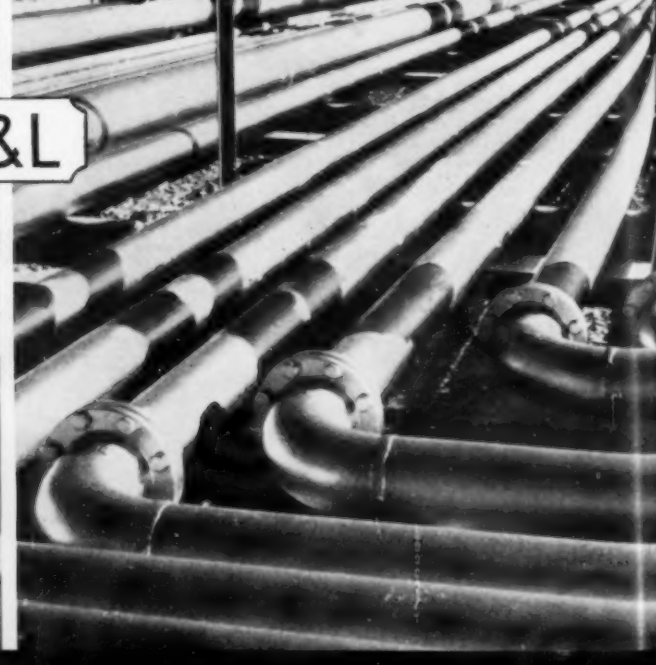

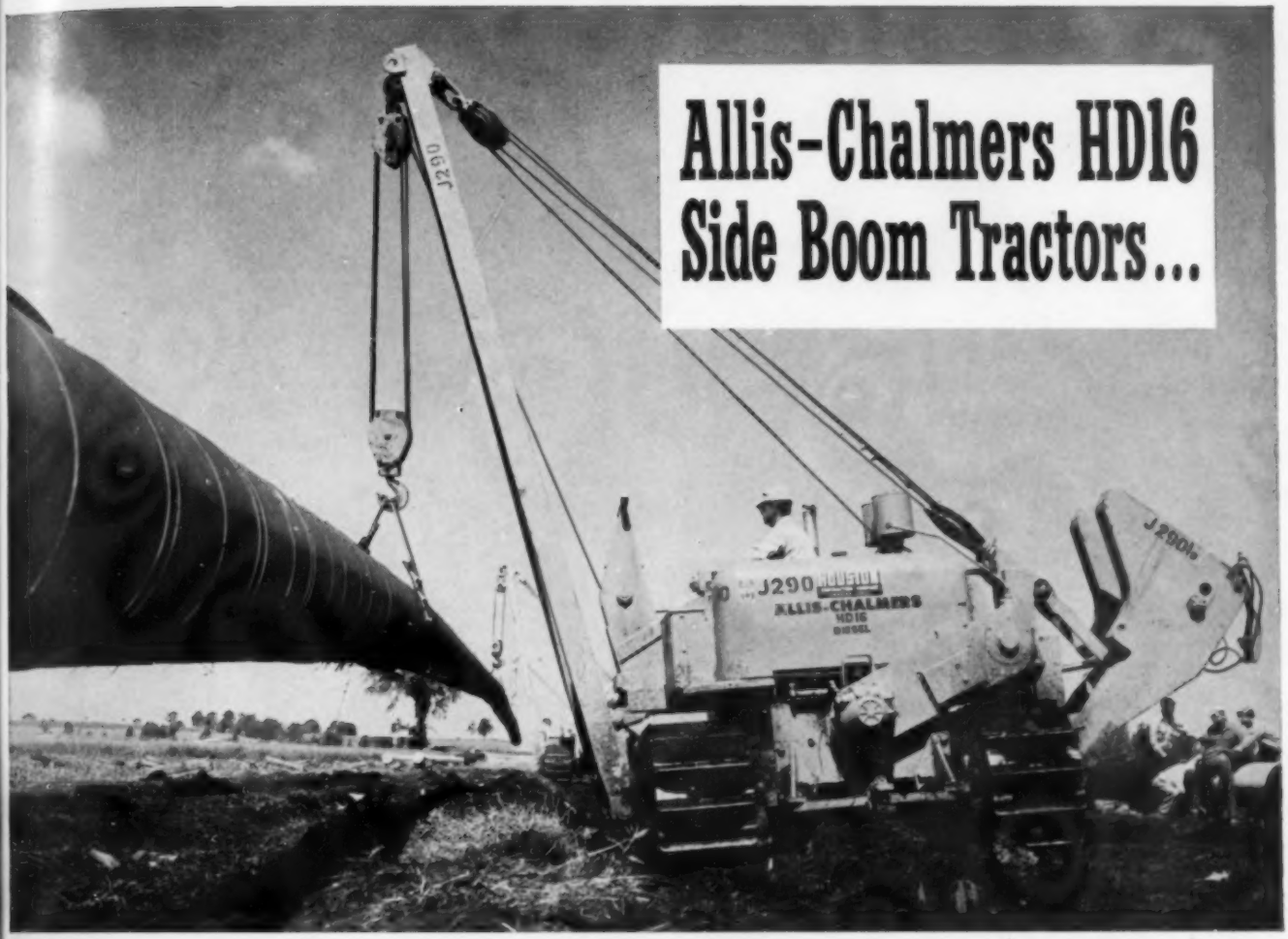

Houston Contracting Company's choice for 24" Michigan-Wisconsin Pipe Line

There's a good reason for one of the leading pipeline construction company's selecting Allis-Chalmers for their job. First of all, the powerful high-clearance HD-16 is the best balanced tractor on the market which means more efficient operation in hilly and boggy terrain. The famous Allis-Chalmers torque converter is standard equipment in the HD-16 FC Boom Tractor and this means easy operation. And when you're laying pipe in hilly and mountainous terrain the Allis-Chalmers HD-16 has plenty of power—not only to pick up a load but to carry it as well. Still another feature of the HD-16 is the Decelerator foot throttle which frees the operator's hands so he can handle the side boom. The HD-16 costs surprisingly little to operate. Its 150 net hp engine can save you up to 27% in fuel over other tractors of comparable size. Permanently lubricated rollers, heavy duty, extra tough tracks keep maintenance costs low on the HD-16.

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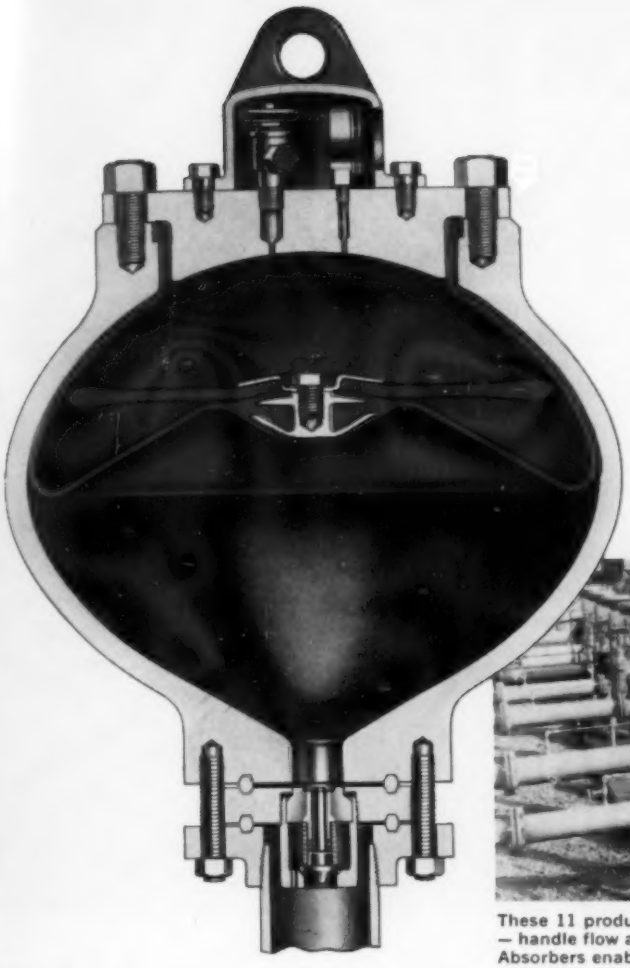

prolongs life of pipelines, fittings and pumps... saves downtime... cuts maintenance costs!

These 11 product transfer lines — some over 1,000 feet long — handle flow at the rate of 1,600 gpm each, yet Hydril Surge Absorbers enable them to be closed in a fraction of a second without over-pressuring lines, fittings or metering equipment.

HYDRIL TYPE "K" SURGE ABSORBER

smooths out shock and pulsation in pipelines

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Hydril Type "K" Surge Absorbers are successfully controlling many types of line surge and pulsation in petroleum product handling lines, water pumping systems and oilwell repressuring programs. Simple design and construction assures long, trouble-free operation. This same oil field-proven Hydril design has been used for many years as a pulsation dampener on high-pressure oilwell mud pumps. Servicing, though rarely required, is readily performed without special tools and without shutting down the system or removing the unit from the line. Available in a wide range of sizes and pressure ratings.

Another dependable Hydril pressure-control product

For more detailed information on Hydril Surge Absorbers, consult your Pipeline or Composite Catalog... or call your Hydril Representative

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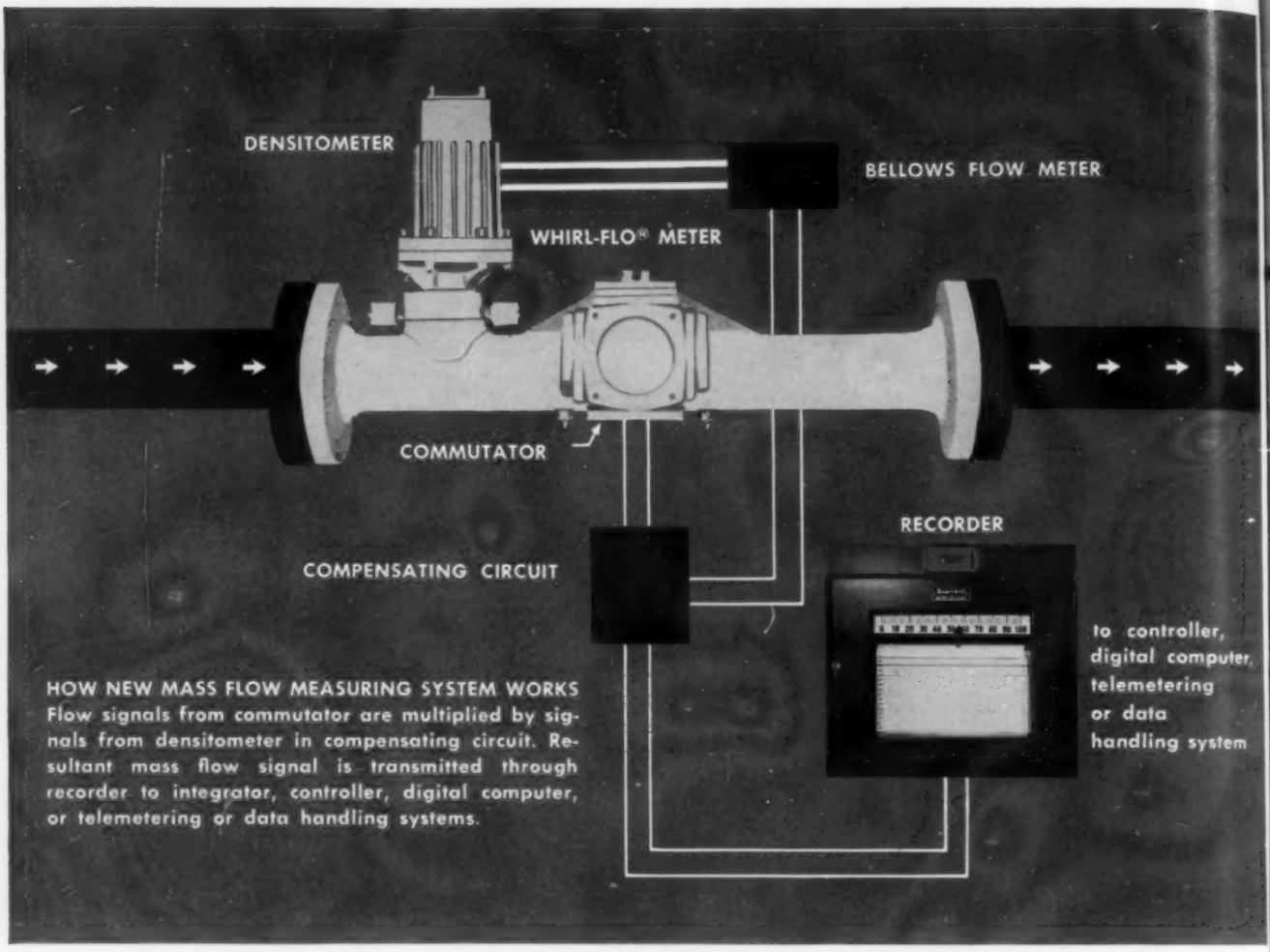
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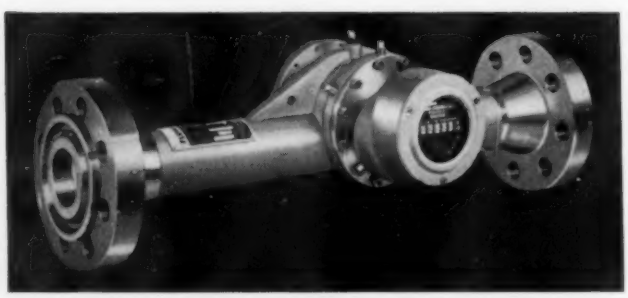
HOW NEW MASS FLOW MEASURING SYSTEM WORKS
Flow signals from commutator are multiplied by signals from densitometer in compensating circuit. Resultant mass flow signal is transmitted through recorder to integrator, controller, digital computer, or telemetering or data handling systems.

NEW HONEYWELL MASS FLOW MEASURING SYSTEM

meters liquids and gases with accuracy of ±½%



Here's the system that delivers *accurate, automatic, and continuous mass flow measurements* of liquids and gases for the most demanding process control, accounting, and custody transfer applications.

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This new mass flow system can be linked easily to telemetering and remote control systems, data handling, and process computers . . . can meter a wide variety of fluids—water, air, propane, butane, natural gas, gasoline, no. 2 fuel oil, ammonia, ethylene, and even some slurries. The flow meter body itself is available in standard sizes from 2 to 16 inches.

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PIPE LINE PANORAMA

Dwindling Returns—Federal Regulation Major Topics at Contractors' Meeting . . . Forty pipe line contractors laid 20 percent more line during 1960 (12,323 miles) for 20 percent less money ($185 million), compared with 1958. The '60 total was up 20 percent over 1959, gross was up 24.1 percent from $149 million reported during previous year. These statistics were quoted at Pipe Line Contractors Association meeting in San Francisco last month to emphasize how cost-price squeeze is eating into contractors' profits.

Business slump, snail-like FPC action, growing emphasis on short loop lines were cited as major reasons for current economic problems.

Result: More contractors are diversifying, looking for work overseas, developing equipment and methods that will cut construction costs.

Looking at 1961, Tennessee Gas Transmission's board chairman Gardiner Symonds says outlook is not really good. He lays much of blame on FPC, says there appears to be a deliberate design to destroy credit of pipe line companies. Symond's feelings were not entirely representative. General attitude at meeting was one of cautious optimism.

Giving valuable word of advice to contractors, Illinois Commerce Commission Chairman George R. Perrine emphasized urgent need for industry leaders to attend congressional hearings, make direct contact with Congressmen, study Landis report, keep well informed on all Washington action that affects their operations. Otherwise, contractors may find themselves completely smothered in federal red tape.

Transco Ruling Snarls Industry Plans . . . A consumer cannot purchase natural gas in the field, even though he will use it himself far from the point of production. This was Supreme Court's 6-3 decision in turning down Circuit Court reversal of FPC's refusal to give green light for Transco to transport gas to Consolidated Edison boilers in New York City—gas that Con-Ed would purchase at the wellhead for 19.25 cents per Mcf.

Questions: What will happen to Texas-Mexico-Southern California gas line? Why worry about a national fuels policy study that might bring about end use controls when Supreme Court gives FPC authority to control end use?

Pipe Line Briefs . . . Full industry accord on natural gas bill is virtually a reality; however, little action is expected in this session of Congress . . . **Leaders in every phase of oil and gas industry are keeping wary eye on President Kennedy's assistant James M. Landis.** His scathing report on regulatory agencies, particularly FPC, plus recommendations for reorganization give ample reason to believe tighter federal control of industry is just around the corner . . . **Alabama state court has ruled that union working assessments are not in violation of state's right-to-work law**—union members do not have to choose between paying assessment and not working, can quit union instead . . . **U.S. producers supplied more than 7½ trillion cubic feet of natural gas to interstate pipe lines during 1959,** up 9.6 percent over previous year, FPC reports. Value: $1.1 billion, for average of 14.3 cents per Mcf. Average cost in 1958—13 cents; in 1957—12 cents.

Coal to Become More Competitive? . . . New technique of "liquefying" coal will permit users to handle it like fuel oil, Texas Eastern and Consolidation Coal Company are now planning to build a 350-mile coal slurry line from unemployment-plagued West Virginia to New York. For details, see Ideas for the Future, Page 50.

Designing Compressor Foundations For Sandy Soil

Vibration plus heavy loading can lead to settlement and possible piping failure unless special care is taken to minimize this hazard in sandy soils

By R. E. Means, Professor of Architectural Engineering and Civil Engineering
Oklahoma State University, Stillwater

BECAUSE THE STATIC LOAD is accompanied by vibration, compressor foundations will settle in sandy soils. This can cause failure in the connecting high-pressure pipe leads producing disastrous results.

In other soils vibration is of little importance.

In order to understand the relationship of *load, vibration* and *settlement,* it is necessary to understand something of the nature of the soil materials on which the compressor station rests. In general, soils may be classified as *cohesionless* and *cohesive.*

Cohesionless soils are those made up of bulky grains. They do not possess inherent shear strength. High shear strength can be developed in these soils by external pressure. Clean gravels, sands and silts are examples of cohesionless soils.

Cohesive soils consist of flat scale-like particles and possess shear strength inherent in themselves. Clays are cohesive soils.

Characteristics of Cohesionless Soils. Clean gravel, sand and silt possess no shear strength except as produced by pressure between the grains. When not confined by pressure they can be poured from a bucket like water but when confined by pressure they become rock-like in hardness and strength.

Sand grains, which are larger than 0.06 mm in diameter, settle out of suspension as single grains. The deposit of sand grains may occur in a loose or in a dense state. In a loose state the grains rest on top of each other with a high percentage of voids as shown in Figure 1. In a dense state the grains are nested in the hollows between other grains with a low percentage of voids as shown in Figure 2.

Void ratio is defined as the ratio of the volume of voids to the volume of solids. The void ratio of sand in its densest state depends upon the shape of the grains and the gradation of sizes. Natural sands in their densest state have void ratios in the neighborhood of 0.5. Loose natural sands have void ratios of about 0.8 to 1.0. Natural deposits of sands may have void ratios intermediate between the densest and loosest states.

The shear strength of sand is caused by friction between the grains produced by normal pressure between the grains and can be expressed as $s = p \tan \phi$, where s is unit shear resistance, p is normal unit pressure, and ϕ is the angle of internal friction. This relationship between normal pressure and shear strength is illustrated in Figures 3 and 4. P_1 and P_2 are the major and minor principal stresses. The surface of failure occurs on planes making an angle of $45 + \frac{\phi}{2}$ degrees with the plane upon which the major principal stress acts.

Silt, whose grains are smaller than 0.06 mm in diameter, settle out of suspension in water as single grains but pile up on the bottom in arches and domes forming a honeycomb structure as shown in Figure 5. The effect of this structure upon carrying capacity and settlement is significant. This discussion of foundations on sand does not apply to foundations on silt.

The carrying capacity of gravel and sand is dependent upon the depth at which the load is applied and to some extent upon the dimensions of the loaded area. From Figure 3 the relationship between confining pressure and the pressure required to produce failure can be expressed as $P_1 = P_2 \tan^2 (45 + \frac{\phi}{2})$. The value of the angle of internal friction ϕ varies with the density of the sand from about 25° for loose sand to 50° for dense sand with angular shaped particles.

Static load applied to sand at some distance below

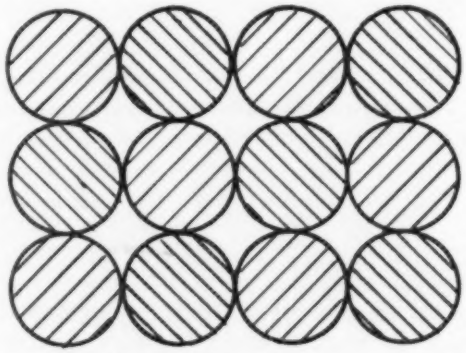


FIGURE 1—IDEALIZED LOOSE SAND can cause foundation trouble for heavy compressors. The weight and vibration can cause settlement, which in turn can cause failure in connecting high-pressure gas lines.

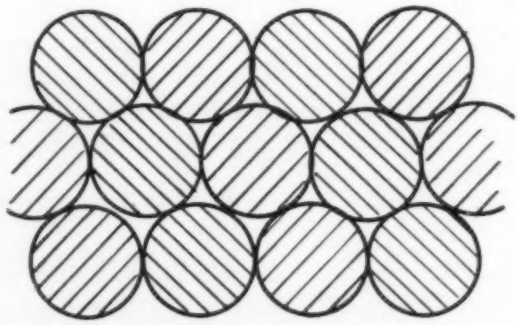


FIGURE 2—IDEALIZED DENSE SAND has a lower percentage of voids because of "nesting." Settlement cannot be produced in dense sand, because any deformation must be accompanied by an increase in sand volume.

the surface causes comparatively little settlements. Vibration of loose sand can cause large and sudden settlements. The vibration momentarily removes the pressure from between the grains allowing them to slide downhill under their own weight to a denser state. The tendency of vibration is to increase the density of sand. Clean sand can be compacted by vibrating when it is dry or submerged. In a moist state, medium and fine sands have some shear strength because of pressure between the grains produced by capillary water. These moist sands do not compact as readily by vibration as dry or submerged sands.

Settlements of foundations on sand can be produced either by vibration causing a volume decrease of the sand under the foundation or by loads heavy enough to cause failure of the soil forcing some of the soil outward and upward allowing a subsidence of the foundation.

Compressor Stations on Sand. Because compressor stations produce vibrations, exceptional care should be taken in the design of foundations for compressor stations to see that the sand is dense enough and that the foundation is deep enough below the surface that excessive settlement will not be produced either by vibration or by contact pressure on the bottom of the foundation. The question immediately arises "How dense is enough to prevent compaction of the sand by vibration?" and "what depth is required to prevent failure of the sand under static and impact pressures?"

Theoretically, a combination of pressure and vibration can compact a sand to the densest state that can be achieved without crushing the sand grains. This densest state for clean sand can be determined by compacting a sample of the dry sand in a small cylinder of known volume by tamping the sand in layers and vibrating the cylinder as the filling progresses. If the deposit of clean sand is as dense as this densest state, vibration and pressure cannot cause volume decrease of the sand. But there can be settlement of a compressor station on a deposit of dense sand. As shown in Figures 3 and 4, the shear strength of sand is dependent entirely upon the pressure between the grains. The pressure P_1 at the corner of the foundation shown in Figure 6 required to produce failure of the sand at this point and force the sand grains out from under the edge depends upon the confining pressure P_3 which is produced by the weight of the overburden. If the foundation is placed on the surface of the sand, the grains at the edge offer practically no resistance to movement of the sand grains. Under the interior of the loaded area the sand is confined by the weight of the building. If the loaded area is large enough and the foundation stiff enough, a considerable static load can be carried on the surface of sand with a pressure distribution as shown in Figure 7. Horizontal compressors that produce considerable horizontal force during operation may produce a rocking motion of the foundation placed too near the surface causing the sand to be forced out and upward with resulting settlement of the foundation. In this manner settlement may be produced even in dense sand when the foundation is placed too near the surface.

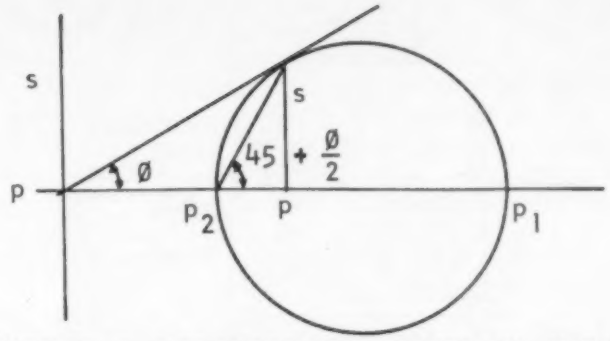


FIGURE 3—RELATIONSHIP BETWEEN SHEAR STRENGTH AND PRESSURE FOR COHESIONLESS SOILS such as sand or gravel. P_1 and P_2 are major and minor principal stresses. Surface of failure occurs on planes making an angle of $45 + \frac{\phi}{2}$ with the plane upon which the major principal stress acts.

The depth below the surface for stability for a given sum of static and impact pressure depends upon the density of the sand and whether the sand lies above or below the water table. The depth required for stability can be estimated as $z = \frac{f_s + f_i}{\gamma_e} \tan^4\left(45 - \frac{\phi}{2}\right)$ when z is depth from surface to bottom of footing, γ_e, is unit weight of soil, and ϕ is angle of internal friction of soil.

As an example of the depth required to prevent failure or displacement of sand from under the edge of the footing the following estimates are made:

Assume $f_s + f_i = 5000$ lb. per sq. ft.

For dense dry or moist sand

Assume $\gamma = 115$ lb. per cu. ft., $\phi = 45°$

$$z = \frac{5000}{115} \tan^4 22.5° = 1.27 \text{ ft.}$$

For dense submerged sand (below water table)

Assume $\gamma_e = 72.6$ lb. per cu. ft., $\phi = 45°$

$$z = \frac{5000}{72.6} \tan^4 22.5° = 2.02 \text{ ft.}$$

For loose dry or moist sand

Assume $\gamma_e = 93$ lb. per cu. ft., $\phi = 25°$

$$z = \frac{5000}{93} \tan^4 32.5° = 8.8 \text{ ft.}$$

For loose submerged sand

Assume $\gamma_e = 61$ lb. per cu. ft., $\phi = 25°$

$$z = \frac{5000}{61} \tan^4 32.5° = 13.4 \text{ ft.}$$

TABLE 1—Relative Density of Sands as Interpreted From Penetration Tests

ASTM Standard Cow Spoon 140# 30"	Manual 1½" Cone 40# 18"	Relative Density	
No. of Blows	No. of Blows		
0-4		Very Loose	Subject to liquefaction if fine grained saturated
4-10	Below 25	Loose	Subject to volume decrease from vibration
10-30	25-50	Medium	Questionable
30-50	50-80	Dense	Little decrease in volume from vibration
Over 50	Over 80	Very Dense	No volume decrease

If the bottom of the foundation is far enough below the surface to prevent failure of the soil, settlements cannot be produced in dense sand. Deformation of dense sand is accompanied by an increase in volume which cannot take place against the pressure which produces the deformation.

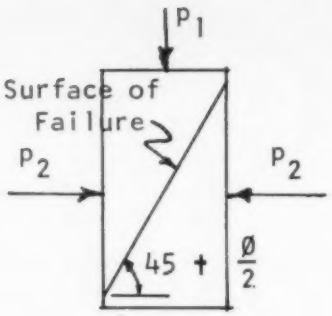
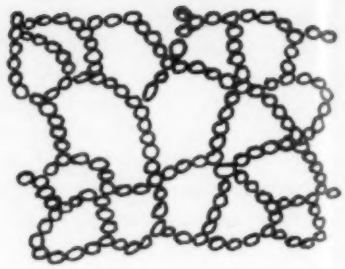


FIGURE 4—FAILURE CONDITIONS FOR COHESIONLESS SOIL (left). See Figure 3 for explanation.

FIGURE 5—HONEYCOMB STRUCTURE of silt (right). Grains of silt smaller than 0.06 mm in diameter, settle out of suspension in water as single grains but pile up on bottom in arches and domes forming a honeycomb structure. This has effect on carrying capacity of soil.



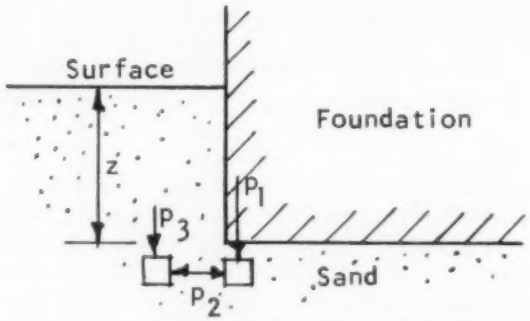


FIGURE 6—FOUNDATION IN SAND. Static load applied to sand some distance below the surface causes comparatively little settlement. Vibration of loose sand can cause large and sudden settlements. The pressure P_1 at the corner of the foundation required to produce failure at this point and force the sand grains out from under the edge depends on the confining pressure P_2 which is produced by weight of the overburden. Where foundation is at the surface grains at the edge offer practically no resistance to movement of the grains.

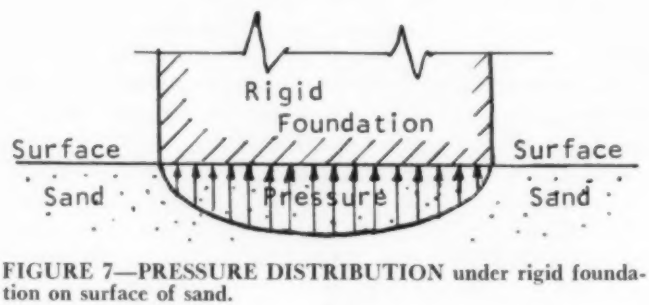


FIGURE 7—PRESSURE DISTRIBUTION under rigid foundation on surface of sand.

Settlements can be caused by vibration of loose sands regardless of the applied pressure or depth of footings. If the moving force is of sufficient magnitude to relieve the pressure between the sand grains, the resulting volume decrease will allow settlement of the foundation without any of the sand grains being forced out from under the edge of the footing.

Investigating Compressor Station Site. In the investigation of a site for a compressor station, if the soil is found to be fairly clean sand, the principal object of the investigation should be to determine the density of the sand in place as well as the thickness and the nature of the underlying soil. The degree of density $\frac{e_L - e}{e_L - e_D}$ is also useful in judging the suitability of the site. e is the void ratio of the soil in place, e_L and e_D are the void ratios in the loosest and the densest states. The void ratio of density of the soil in place can be determined from an undisturbed sample taken from a test pit or excavation. Except by freezing and coring or other expensive method, it is practically impossible to obtain an undisturbed sample of clean sand from the bottom of a bore hole.

Some idea of the density of sand at the bottom of a bore hole can be obtained by driving a standard device a standard distance into the soil with a standard hammer falling a standard distance. A so-called standard penetration test was adopted by the ASTM in 1958. This test consists in driving a standard split spoon sampler, sometimes called a Gow spoon, for a distance of one foot into the soil at the bottom of a bore hole with a 140 pound hammer falling 30 inches. This test requires power equipment. Another test that has been used by the writer consists of driving a 1½ inch diameter 60° steel cone secured to the end of a one-inch I.D. steel pipe with a 40 lb. hammer falling 18 inches. The number of blows required to drive the cone one foot into the soil at the bottom of the bore hole is indicative of the density of the sand. Proposed relationships between number of blows for a penetration of one foot are given in Table 1.

In interpreting this table it should be borne in mind that several factors affect the resistance to penetration. The values given in this table apply to the resistance at the bottom of a bore hole not less than five feet below the surface. The resistance for one foot penetration from the surface of an excavated area is much less than at the bottom of a bore hole. Factors affecting the resistance to penetration are: depth below the surface, size of test hole, position of water table, size of sand particles, and amount of clay binder.

Case History I. On a site in the Platte River Valley in Western Nebraska 16 feet of medium sand overlies nine feet of gravel below which is five feet of loose fine sand which in turn lies on gravel. Manual penetration tests showed resistances in the medium sand of 18 to 22 blows per foot, in the gravel above the loose sand 70 to 80 blows per foot, and in the gravel below the loose sand 100 blows per foot. Reasoning that a small station would not affect the loose fine sand at 25 feet below the surface and because of the expense of lowering the ground water, a thick slab to receive three V-type compressors was laid on the sand at the water table. Four feet of fill was placed around the outside of the building to provide six feet of confining overburden. Two of the units were installed, one in the middle and one at one end of the mat. During the first year the end engine was run continuously at full load. Because of mechanical difficulty, the middle engine was run only a short time during the first year. At the end of the first season's operation, the outside edge of the end engine had settled 0.37 inch, between the engines 0.5 inch, and the outside of the middle engine 0.1 inch. At the end of four years operation with both

engines under full load, the outside of the end engine settled 2.5 inches, between the engines 2.75 inches, and the outside of the middle engine 1.5 inch.

Case History II. A similar station in Kiowa County, Kansas, with a foundation 11 feet below the surface on sand which offered a resistance of 33 to 45 blows for one foot of penetration with the water table 20 feet below the surface produced no measurable settlement.

Treatment of Loose Sand. When the sand on which the station is to be placed is found to be loose, several alternatives are possible.

An attempt can be made to compact the sand by driving piles into the loose sand. The difficulty with this method is that after the pile penetrates only a short distance into the sand the resistance to penetration becomes so great that jetting is used to keep the sand around the pile loose enough that the pile can be driven. Loosening of the sand by the jet may completely eliminate the compaction produced by driving the pile.

It is possible that the sand around the pile may be looser after insertion of the pile than before. Settlement can be prevented by driving or jetting the piles for bearing on a layer of rock or into a layer of dense sand below the loose layer. Such a foundation, although it prevents settlement, may not be a satisfactory one for a compressor station.

Case History III. A station in Sedgwick County, Kansas, consisting of several 1000-hp, gas engine-driven horizontal compressors was constructed on a 50-foot layer of Arkansas River sand. The compressors were mounted on concrete blocks extending through a basement and resting on a thick reinforced concrete slab. Piles were jetted through the sand layer and driven into the hardpan layer below. The concrete slab was cast on the sand with the pile caps extending a few inches into the slab. These engines as they operate get in step to produce in and out of phase cycles. While operating in step they produce large horizontal forces on the slab at the pile caps.

Almost immediately after the station was placed in operation large earthquake-like deformations were produced during the in step portion of the operating cycle. Horizontal acceleration of the building caused rivets to be broken and to fall out of joints in the steel building frame. Investigation disclosed that the sand that had been loosened by jetting had settled away from the bottom of the slab leaving a void of several inches.

Pressure grouting into the sand at depth closed the void and applied pressure to the surface of the sand. This treatment reduced the horizontal deformation to a value comparable to that produced by similar stations on hard clay. At the time grouting was done a non-synchronizing device was installed to prevent the units from getting in step. The station operated normally for about eight years. At the end of this period the non-synchronizing device was removed with no appreciable increase in deformation during the in step periods. Gradually the amplitude of the horizontal deformation increased until it became the same as before the grout treatment. Exploration revealed that only a small void, not more than $\frac{1}{32}$ to $\frac{1}{16}$ inch, existed between the slab and the sand between the piles. In all this time no appreciable vertical settlement had occurred.

The writer has reasoned that when the pressure was taken off the sand at the bottom of the slab the sand lost its shear strength at the surface and offered no resistance to lateral deformation of the pile caps. Several feet below the pile tops the weight of the sand above created considerable resistance. When the sand was pressure grouted, the cement paste did not enter the pores of the sand of this grain size but formed lenses and fingers which lifted the sand and exerted pressure against the bottom of the slab. The sand between the lenses of grout was subjected to static pressure which had little effect upon its density. The original shaking of the loosened sand had compacted the sand to such an extent that the vibration caused without synchronization was not sufficient to produce additional compaction, but not dense enough to prevent a small amount of volume decrease under the greater force exerted when the units were allowed to get in step. This small decrease in volume removed the pressure from the sand under the slab causing the sand to lose its strength and to allow lateral deformation similar to that experienced originally.

In using piles to compact loose sand the volume of the piles should be only sufficient to compensate for the volumn change from the natural void ratio to the void ratio in the densest state. The piles should be driven without jetting. The pile tops should be covered with sand and the slab laid on the sand above the piles.

Under favorable conditions loose sand can be compacted with a large capsule type vibrator having a water jet at the bottom and at the top with controls so that each jet can be operated independently. With the bottom jet operating the vibrator can be easily pushed into the loose sand. When the depth to which compaction is to be done is reached, the bottom jet is shut off and the top jet applied to the sand above the capsule. The vibrating capsule is slowly worked to the surface compacting the loose submerged sand as it rises. Each penetration of the capsule will compact a cylinder of sand the diameter of which depends upon the nature of the sand and the energy of the vibrating mass. The size of the compacted cylinder can be estimated from the size of the depression formed after the vibrator has been removed.

Submerged sand for depths of five to six feet below the surface of an excavation carried to the water table can sometimes be compacted successfully with a large concrete vibrator. A steel blade about four inches wide by $\frac{3}{16}$ to $\frac{1}{4}$ inch thick and five feet long strapped to the vibrator is inserted into the submerged sand as the vibrator operates.

—The End

About the Author

R. E. Means is professor of architectural engineering and civil engineering at Oklahoma State University, Stillwater, Okla. He received his education in civil and architectural engineering at Kansas State College and Oklahoma A. & M. College (now Oklahoma State University), University of Illinois and Harvard University and holds B. S. and M. S. degrees from these institutions. His professional experience is very broad and he has been teaching and consulting since 1923. He has published many papers on structural problems based upon considerable research in this field.

Magnetic Particle Inspection at Regular Intervals Can Prevent Major Troubles

This method of testing critical station components is saving on maintenance bills

By Sam Vance
Field Engineer
Magnaflux Corp., Dallas

MAGNETIC PARTICLE METHOD of inspection is becoming more and more popular as a preventive maintenance tool. It can be used in hazardous locations with safety; it is inexpensive, requiring only a magnetizing power source, a few cables, iron particles, a "black light" and a trained inspector.

Critical engine and compressor parts require inspection and maintenance. Crossheads, for instance, often develop cracks around the pin holes; piston rods develop fatigue cracks in the threaded sections where they have galling at the stuffing box. This galling is evidenced initially by minute fatigue cracks which eventually develop into peeling. Crank pins are also very critical. Connecting rod stud and bolts as well as head studs and bolts develop fatigue cracks in the threaded sections. Key ways on shafts are also critical areas.

How it Works. The magnetic particle inspection method is suitable for the inspection of all ferrous parts. It is applicable however only on magnetizable materials and cannot be used on non-magnetic steels. If the discontinuity lies sufficiently close to, or actually breaks the surface, some of the lines, of course, break out of the surface and set up external poles, like a horseshoe magnet over the defect. The local poles, which form at the surface over the defect known as a "leakage field," attract and hold the magnetic material when it is applied to the surface of the part.

Not all defects in a given part can be found with the use of one direction magnetization. Therefore, a part should be inspected using a circular and longitudinal field for locating all defects present. Circular fields are produced by passing current directly through a part and are used to find defects lying parallel to the length of that part. Longitudinal fields, however, are passed through a part generally parallel to its lengths and discontinuities in the direction transverse to the length of the part will be found in this type of field.

This method of setting up a longitudinal field using a coil carrying the current will not intercept a crack parallel to the length of the part and it will not produce a magnetic particle indication. In the case of a hollow part, however, a circular field may also be established circumferentially by passing current through a bar or cable threaded through the opening in the part. This method produces a uniform field in a cyclinder or around the hole without need to make electrical contact in any point on the part and is very effective for locating radial cracks.

Half Wave Is Best. Three types of current are employed in this method: half wave DC and AC, and full wave DC. The intensity and distribution of

FIGURE 1—Crack through lashing wire hole of turbine blade next to broken blade as revealed by magnetic particle inspection.

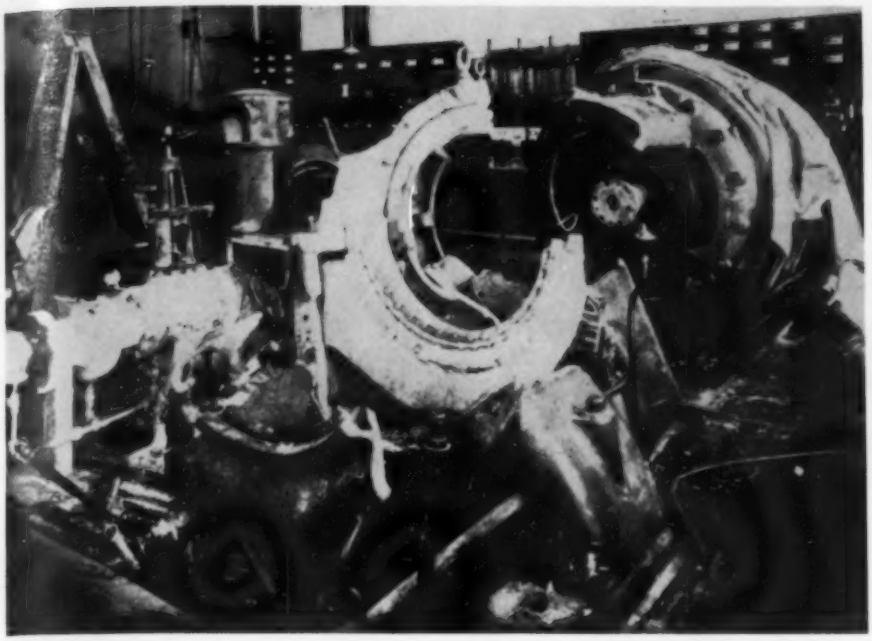


FIGURE 2—Violent turbine explosion caused by wheel crack fatigue failure.

a field are affected by the amount and kind of magnetizing current used. Direct current, in general, produces fields penetrating deeply into the metal. Alternating current, because of the skin effect, produces fields which are confined to the surface layer of the metal, especially in heavy sections. Direct current may be steady, as when produced from full wave rectified three phase alternating current; or it may be pulsating when obtained from half wave rectification from single phase alternating current. The half wave current is the most sensitive for locating subsurface defects in welds or castings. On the other hand, the AC current is far better for maintenance purposes.

The dry powder method is particularly recommended for welds, castings and fittings. However, to locate the smallest defects (even in grooved, splined or thread sections) fluorescent magnetic particle inspection provides a brilliant, hard to miss, fluorescent indication. There is little difference for the most part locating surface defects by the use of any of the three types of currents. However, assuming that internal discontinuities have been eliminated during manufacture, the surface defects such as fatigue, thermal and vibration defects are the trouble spots.

Typical rod inspection. Following is a suggested operating procedure for a connecting rod inspection of a large stationary engine: Many times, during a maintenance program, the engine is not completely torn down, and for this reason there are two methods of inspection: in-place rod inspection and removed-rod inspection.

In-place inspection. The engine should be cooled to room temperature and the rod cleaned in a commercial solvent to remove the engine oils. The normal engine oil will fluoresce under black light and, for this reason, thorough cleaning is necessary prior to the fluorescent magnetic particle inspection. Rods must be positioned so they are accessible to inspection and this necessitates positioning the crankshaft several times during a complete inspection operation. The in-place rod inspection is performed with a 1,000 amps AC current through a three-turn coil. The entire inspection is performed under the black light using fluorescent magnetic particles to assure good results. The coil magnetization is done in three steps along the length of the rod. The inspection begins at the top of the rod. Current is applied to the three-turn coil and the fluorescent magnetic particle material is sprayed on by means of a hand held spray gun. The processed segment of the rod is then inspected under the black light and any defects will appear as a yellow fluorescent line. The next coil position is 10 to 12 inches below the first and the same magnetizing level is used. The third position is at the bottom of the rod and the entire procedure is repeated.

Demagnetizing. After the inspector has marked any defects found and the inspection is complete, demagnetization follows. This is accomplished by using the same three-turn coil but with a maximum AC output in the coil. The coil is wrapped in the same manner as when used for magnetization. It is then lowered from the top to the bottom of the rod. At the bottom of the rod, a 30-point automatic demagnetizing switch is used to complete the demagnetization cycle. This in-place inspection of a connecting rod using the coil method only, should find most of the fatigue cracks present.

Removing rods from the engine. Should complete immunity from fatigue cracks be the goal of this inspection, rods should be removed from the engine. Again the rods must be properly cleaned. Since many of the connecting rods have oil holes down the center, the central conductor made of a high conductivity copper can be used. The conductor is inserted through the oil hole, and contact with the ends of the central conductor is made by using contact clamps. Alternating current of about 1,000 amps is applied to the central

FIGURE 3—Series of short cracks in fillet of a turbine shaft which can cause turbine failure.

FIGURE 4—Cracks in turbine throttle valve body. Note how several holes have been drilled into the crack to determine its depth.

FIGURE 5—Dye-penetrant testing method reveals cracks in turbine throttle valve body.

FIGURE 6—Hole made through turbine throttle valve (stop valve) to remove cracks shown in Figure 5 revealed by dye-penetrant.

FIGURE 7—Completed weld in body of turbine throttle (stop valve) to fill hole shown in Figure 6.

conductor from the magnetizing unit. The fluorescent magnetic particles are again applied to the entire surface of the rod while the current is flowing through the central conductor. In this manner, longitudinal defects in the rod will be found. After the circular magnetization has been accomplished by using the central conductor, the coil method is again used on the entire length of the rod as in the in-place rod inspection. Use of the removed-rod inspection procedure is a safe method to insure freedom from defects. As pointed out, the majority of defects will be in a transverse direction found by the coil method. If complete inspection is desired, the removal of the rod with the inspection in both directions is necessary.

Inspecting turbine blading etc. Every time a turbine starts up or is called on for greater loads, the turbine blades are subjected to extremely high stress due to the combination of centrifugal torsional bending and vibrational forces accompanied by high temperature and these are particularly susceptible to fatigue failure. Breakage of one blade can cause the complete destruction of an entire row of blades, as well as many other rows. The spindle body, the turbine blades, the shrouding, the lashing wires and the journals are all inspected for surface cracks. The fluorescent magnetic particle method shows up any indication of defects in the magnetized part. The shallow cracks that possibly will not impair the serviceability of the part can be ground out by blending the adjacent metal to avoid stress raisers that could themselves produce defects.

Cracking in turbine blades is serious and requires the removal of the defective blades. However, a fatigue pattern may become evident in a row, which would necessitate the removing of an entire row. Figure 1 shows a broken spindle blade and alongside, another blade with a crack through the lashing wire hole. This is clearly outlined by magnetic particle inspection. If preventive maintenance inspection does not catch these types of fatigue defects, then Figure 2 shows what can happen.

In many cases the areas to be inspected are not so easily seen by the inspector. In places like the underside of blading shrouds and lashing wires, which sometimes may have faint indications, can be overlooked. The fluorescent magnetic particle indications glow brightly under the black light and are more noticeable than a buildup of dry powder. Figure 3 shows a crack around a shaft fillet and the magnetic particle indications point to the direction and the extent of the defect. In some cases short small cracks may join to form a continuous circumferential crack of considerable depth.

Valve inspection and repair. Occasionally, a valve body will have a number of internal surface defects. A few may be visible to the naked eye but a far greater number will be located by nondestructive testing. Sometimes, a number of such cracks will tie in to form one long defect.

Figure 4 shows such a defect. Exploratory grinding and probing with a small drill indicates cracks were not shallow but penetrated deeply into the interior of the wall. The questionable metal had to be completely removed. As grinding progressed, frequent checks were made to insure the complete removal of the defect. A red visible dye penetrant was used to keep close watch on the grinding procedure. The penetrant was sprayed over the area and allowed to soak for a short time. The excess was removed and a developer used to bring the remaining penetrant in the defect back to the surface where it could be seen.

Figure 5 shows that the subsurface condition was worse than the original surface condition indicated. As shown in Figure 6, it becomes necessary to completely remove the entire area through the wall before the last remaining dye penetrant indication disappeared. The hole is filled by welding and checked by magnetic particle inspection to insure the soundness of the weld. Figure 7 shows the completed weld. —The End

About the Author

Sam Vance is a field engineer with Magnaflux Corp. of Dallas. He has been with this company since 1954 when he graduated from Bradley University of Peoria, Ill., with a B.S. degree in industrial education. Vance is active in the Society for Nondestructive Testing, The American Society of Metals and the Locomotive Officers Maintenance Association.

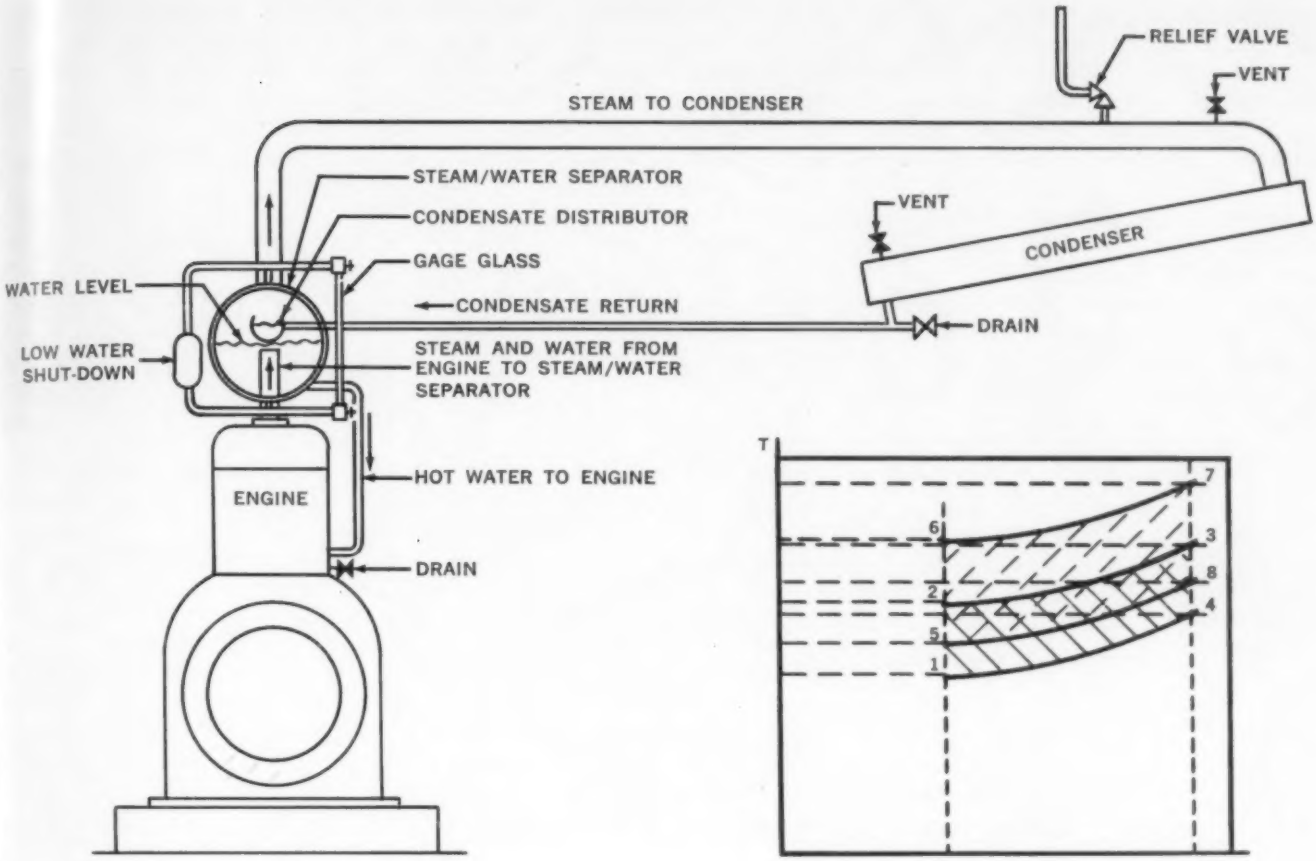


FIGURE 1—Schematic drawing of ebullient cooling system. To start engine, air is first removed from system through vent. As engine runs, water starts boiling in engine jackets, and hot water and steam surge up into header above engine. Steam is separated for cooling and the hot water returns to engine. After steam is condensed, condensate is returned along with hot water.

FIGURE 2—The apparent improved thermal efficiency. Normal engine temperatures are indicated by points 1, 2, 3 and 4. If initial temperatures are increased to 5, 6, 7 and 8 the latter has the greatest area and apparently the greatest thermal efficiency.

The Low First Costs and Many Benefits of Ebullient Cooling

Here are some of the pros and a few of the cons on this controversial subject

By H. W. Evans, Assistant Superintendent Engineering Division, Sinclair Oil & Gas Company, Tulsa, Okla.

EBULLIENT COOLING SYSTEMS are a highly controversial subject. Their advantages and disadvantages versus those of conventional cooling are a constant source of discussion. Arguments most frequently heard in favor of this type cooling are: *increased thermal efficiency; lower initial cost; more dependable operation; lower maintenance costs; better cooling; less oil contamination; better lubrication; reduced engine wear,* and *less down time.*

Arguments for the conventional radiator with jacket water pump are: *better public knowledge and acceptance; lower operating temperatures; less gasket trouble,* and *fewer lubrication problems.*

Because benefits of the conventional cooling system are well understood by most users, no attempt will be made to catalog or detail the arguments in favor of the system.

HOW EBULLIENT COOLING WORKS

Figure 1 is a schematic drawing of an ebullient cooling system. The steam and water separator is above the cylinder and as close to it as possible. The most recent design applied to a

multi-cylinder engine is a horizontal, large-diameter pipe running directly over the cylinder. This replaces the conventional cooling system inlet and outlet water headers. It must be sized to provide adequate disengaging surface for generated steam, plus storage space for enough water to operate for an hour or more without make-up from condensing steam. The pipe must accommodate a simple deaerating section and condensate distributor; and, it should allow sufficient flow so that water returns to the water surface before steam enters the pipe. It is usually equipped with a low water shutdown device, sight glass, water drain and relief valve (sometimes the relief valve is installed on the steam piping outside the installation building).

Steam is generated as the engine is started and heat is picked up by the jacket water. This steam rises in the jacket, carrying water to the steam and water separator where separation is made. The water returns to the lowest part of the engine jacket, while the steam is piped to a heat exchanger (condenser).

To start an engine equipped for ebullient cooling, air must be removed from the system. Vents for this purpose are placed in the highest point of the steam piping and in the condensate header of the steam condenser. If the system is designed to work without positive steam pressure, the vent in the condenser header is always kept open to prevent vapor lock. Condensed water is returned to the steam and water separator where it flows at reduced velocity, stabilizing at its boiling point before returning to the cylinder jackets. Designing for proper velocities, induced by heat content, is important with this type cooling.

A water seal installed in the condensate return pipe prevents the steam from flowing to the cooler through this condenser exit. A drain installed in the return pipe permits the water seal to be drained in case of cold weather shutdown. For this same reason, drains are also installed in the lowest part of engine water jackets, which would also serve for blowing sludge out of the system.

Some important advantages of ebullient cooling:

Improved thermal efficiency . . . still not proved. It is often said that engines cooled by ebullition are more efficient than those with standard jacket water cooling. While a theoretical treatment is impractical in this article, let us briefly consider the temperature entropy diagram (Figure 2).

Normal engine temperatures are indicated by points 1, 2, 3 and 4. If the initial temperature is increased from point 1 to point 5 and points 6, 7 and 8 of the new diagram are calculated by perfect gas laws (assuming specific heats remain constant), the area 5, 6, 7 and 8 becomes greater than the area 1, 2, 3 and 4. However, this increase is not all profit. In a naturally-aspirated engine, volumetric efficiency is reduced because of increased charge temperature. Where fuel conditions allow, the engine tends to detonate at higher temperature. Therefore, the net gain may not be as much as might be expected.

Many attempts have been made to exactly determine increased thermal efficiency (if any), but results have been varied and no generally accepted conclusions have been reached. In fact, some claim that in actual tests ebullient cooling did not increase cylinder temperature at all.

COSTS ARE LESS

Ebullient cooling system cost varies considerably, depending on design standards of the user. When materials comparable with conventional systems are used, a reduction in installation cost is possible. Less heat transfer surface and smaller fan motors are required to condense steam than to remove the same amount of heat by cooling 150° F jacket water. There is an additional saving by eliminating the jacket water surge tank, temperature control, bypass water pump and water pump drive.

Conventional radiators have been used as steam condensers with good results. However, with some installations, part or all of the savings have been sacrificed by using round tube sections instead of the less costly radiators. There is also a tendency to spend considerable money on unnecessarily complicated steam and water separators. And, many manufacturers of standard cooling systems add an extra engineering fee to the cost of ebullient cooling systems because these depart from their standard practice.

Ebullient cooling systems more reliable. Because ebullient cooling requires fewer operating parts, the possibility of shutdown due to system failure is reduced.

It has been proved that even continuous overload can be carried without overheating an engine. However, overload can be a source of considerable trouble if not properly controlled because overheat operational factors may become critical.

Experience with twelve cylinder "V" type engine installations demonstrates this point. One of the magnetos failed, leaving half the cylinders carrying the load. Since the unit was unattended, exactly what happened is not known. However, it appeared that the higher rate of heat transfer from the ebullient cooling system permitted the engine to keep running for a considerable length of time. Due to the probable combination of a too-rich gas mixture and extremely high explosion pressures and temperatures, the oil film was removed from the cylinder walls, allowing the pistons to gall and stick. This engine is now equipped with protective devices to prevent any such recurrence.

With higher temperatures and overload, there is a possibility that detonation may occur. If so, the maximum load carrying capacity of the engine is slightly reduced. A major engine manufacturer has demonstrated this in their test laboratory.

Another application of ebullient cooling was made on one of two horizontal compressors at a gas gathering station near Asher, Okla. Both units had the same compressor cylinders and were identically connected to suction and discharge headers. As load increased, the unit on conventional cooling began to detonate and leak water at the head gaskets. Yet at no time did the head gasket leak in the ebullient cooled engine. During the period of test, repairs for the engine on ebullient cooling definitely cost less.

All in all, Sinclair's experience indicates ebullient cooling to be more dependable.

Maintenance shows reduced costs. Ebullient cooling reduces calcium and other deposits in engine jackets. In fact, there is no record of any deposits being formed in such engines.

There has been some trouble with standard gaskets on ebullient cooled engines. This has been overcome by replacing the all-rubber gaskets vulnerable to heat, with proper neoprene, or other suitable high temperature material.

There are no reports of excessive wear due to higher jacket water tem-

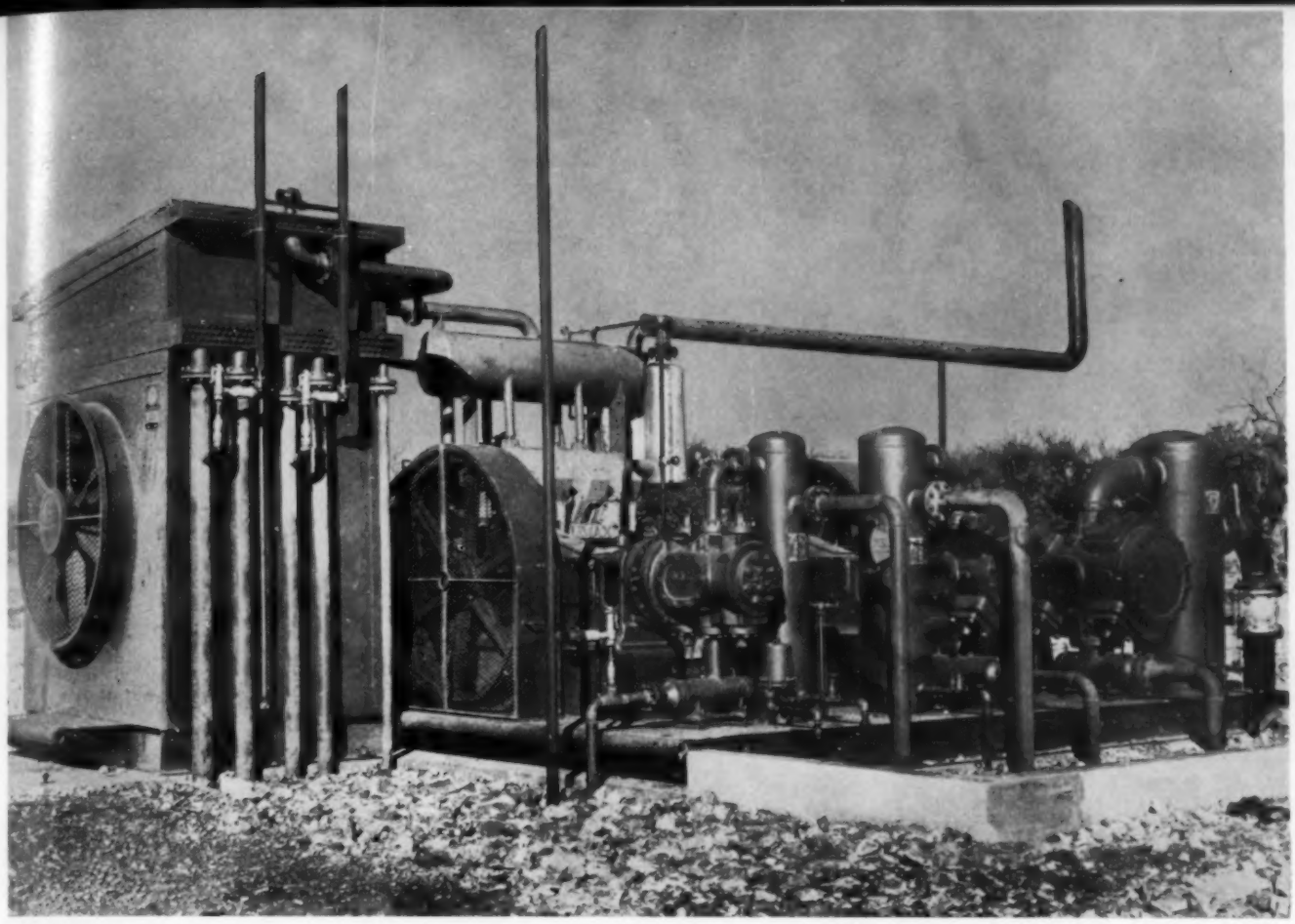


FIGURE 3—Typical ebullient cooling installation. This is Sinclair's gas booster station near Eldorado, Texas. A similar installation located near Tatum, New Mexico, has been operating continuously without standby at about 20 percent overload.

perature—actually, they seem to show less wear. However, with modern lubrication and filtration for all installations, engine wear has been reduced to the point where it is difficult to draw any definite conclusion for one system over another.

Experiments are being conducted on engines where heat is removed from the lube oil by ebullition. The oil performed satisfactorily at operating temperatures of 230° F. On inspection, a notable reduction in sludge was found in the crankcase and there was no trace of deposits on the pistons and rings. But, while the valves were in very good condition, several of the pistons were galled. This, however, was caused by a lack of clearance between the piston and liner and not by lube oil failure. The pistons were made of aluminum and no initial allowance was made for their increased operating temperature under hot oil and overload conditions. On several occasions, these engines have operated at 20 percent overload. While this experiment is being continued, no additional installations will be made until the definite cause of piston failure is determined.

There was no sign of acid corrosion in the hot oil engines. It is believed that by keeping oil temperatures above the boiling point of water, free water was eliminated from the crankcase. Whether or not this will extend the usable life of lube oil remains to be seen.

Engines with ebullient cooling are noticeably hotter externally. This can be objectionable, particularly when building ventilation is poor, or when it is necessary to make adjustments during engine operation. Good ventilation is the best solution to this problem.

Coolants—problems being solved. While pure water is the best medium for transferring heat from the cylinders to the air fin cooler, its disadvantage is the 32° F freezing point. An unattended engine going down during cold weather can be a real calamity. A number of methods have been tried to overcome this difficulty. Tanks have been buried and automatic drains installed to drain the system in case of shutdown. This proved both expensive and unsuccessful because the drain valve would not always operate. A glycol-water solution has been used but this method left the condenser without protection. A glycol-water-alcohol solution has also been used and this gave some condenser protection, but alcohol is difficult to keep in the system. It is also dangerous because if a leak develops, glycol solution might seep into the crankcase.

Experiments are being conducted on a new coolant, which promises to overcome many of these difficulties. A 50-50 solution of this coolant and water forms an azeotropic solution which has the following physical properties: boiling point, 280° F; pour point, -- 50° F; sp. gr., 0.99; and latent heat of vaporization, 670 btu per pound. Heat transfer ability is about the same as water. While some corrosion has been observed in admiralty bronze tubes, an inhibitor is expected to be available soon.

Heat transfer controls—none required. No mechanical controls are required to remove heat from engine jackets by ebullition and it is fast and positive. As fast as heat is transferred through the cylinder walls to the water, steam is generated which immediately rises in the water. The steam moves upward, inducing a flow

of water in the direction of steam flow—this is in addition to the thermosiphon effect usually talked about. The water energy level is highest at the water-steam boundary in the separator; lowest, at the bottom of the jacket. Naturally induced flow is upward as heat is added to jacket water.

The amount of water circulated is determined mainly by the pipe size. Cylinder jackets must always be flooded with water. Circulation should be about 10 pounds of water per pound of steam generated.

For conversion to ebullient cooling, an engine must have a clean steam path for upward flow through the cylinder to the separator.

In a properly designed system water temperature inside the jacket remains constant at its boiling point, assuring best ebullient operation. Steam and water separators are installed just immediately above the engine cylinder, to keep water head at the cylinder inlet at a minimum. This is because increased pressure raises the boiling point, making it necessary to add sensible heat in the initial stages of the cooling cycle. Since there is not enough velocity or turbulence to permit adequate heat transfer under these conditions, hot spots could develop near the water inlet. This is especially critical in a two-cycle engine where the exhaust port is near the water inlet.

Condenser—simple rules, few troubles. The steam condenser should be placed high enough above the steam and water separator in a gravity system to assure the condensate returning to the separator. The distance between the separator and condenser is not important to the system operation. When desirable, the condenser may be placed below the separator and the condensate pumped back up to the system. However, while pumping horsepower is very small, it adds a non-essential component to the system.

Eight-foot condenser tubes are most commonly used and seem to be an ideal length. The increased cost of the short tubes is offset by their greater efficiency.

Hydrate trouble during cold weather is often caused by placing gas cooling coils ahead of the condenser in air exchangers. To prevent this, an automatically controlled shutter and duct can be built to divert air discharged from the cooler back to the fan suction.

To prevent accumulation of condensate in the steam pipe, the pipe can be sloped to the condenser back to the separator.

AUXILIARY EQUIPMENT A MINIMUM

Little additional equipment is required; probably the most important auxiliary is a reliable pressure relieving device.

An ebullient cooling system should be treated as a steam boiler, even though it operates at little or no pressure. If the condenser fails, an alternate steam path must be provided to avoid explosion. This is not a cause for alarm since every operator knows how to relieve excess pressures. A sight glass, low water shutdown, and air eliminator help make for reliable operation.

Drain cocks in the bottom of each cylinder and the low points of the piping are needed to drain the system in case of a cold weather shutdown.

A two-speed fan motor and temperature controller are sometimes used for steam condenser air supply. An automatically controlled variable pitch fan has also been successfully used to control air volume.

Lubricant performance improving. Recently, some lubrication troubles such as deposits on pistons and rings have been blamed on ebullient cooling. Our lubrication and research engineers have developed oils for high temperature operation, which minimize these deposits. This development work is continuing and even better oils can be expected.

Sinclair engineers find engines with ebullient cooling indicate better lubrication characteristics than those with standard cooling systems.

Figure 3 shows a typical ebullient cooling installation. The packaged horizontal compressors are operating in gas booster stations for Sinclair Oil & Gas Company's Plant 23 near Eldorado, Texas. The engine-compressor units installed at Sinclair Oil and Gas Company's Plant 29 near Tatum, N. M., are operating continuously without standby at about 20 percent overload.

The compressor cylinders are operated without cooling liquids in the water jackets—a standard practice with ebullient cooling systems. Compressor cylinders, with water from the ebullient system in the water jackets, have been tried to provide cooling for the valves in case of trouble. However, the high water temperature resulted in a loss of gas handling capacity of the compressor cylinders. A better method of preventing damage when valve trouble occurs is to install a high temperature shutdown in the discharge from each compressor cylinder.

Many notably successful power engine installations have been made using virtually the same systems described in this article. Unattended field operation is the best "proving ground." Where engine design permits, ebullient cooling will most often do a better job of cooling an internal combustion engine than a conventional radiator system with a water pump. It is being used on an increasing number of oil field engines.

Certainly, satisfactory or economical operation can be achieved with conventional air cooling. However, there is real evidence that using ebullient cooling with lubricants specifically compounded for high temperature service will give more reliable operation with less maintenance cost and downtime.

When cooling system decision is approached with economy in mind, well-engineered ebullient cooling has definite dollar-saving advantages that should be carefully evaluated.

ACKNOWLEDGMENT

Photos courtesy POWER AND FLUIDS, Worthington Corporation, Harrison, N. J.

About the Author

Harry W. Evans, assistant superintendent of the Engineering Division of Sinclair's Gas and Gas Products Department is an engineering graduate of Oklahoma State University. His contact with the oil patch started early; he was reared in the oil fields near Keifer and Glenpool, Okla. Since graduation from OSU, Evans studied petroleum refinery engineering at Tulsa University and has been active in several engineering design projects including application of ebullient cooling of gas compressor units.

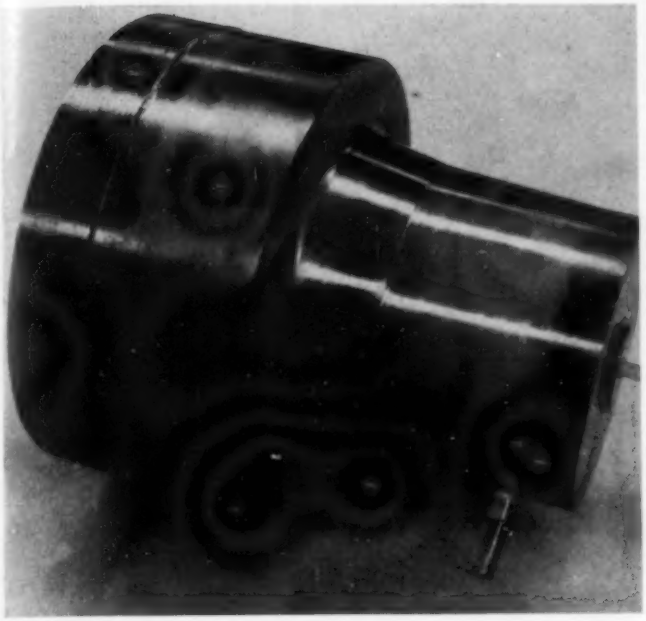


FIGURE 1—Plastic model (quarter-size) of actuating cylinder of large gate valve. To study stresses, this part is heated to critical temperature, stressed and cooled.

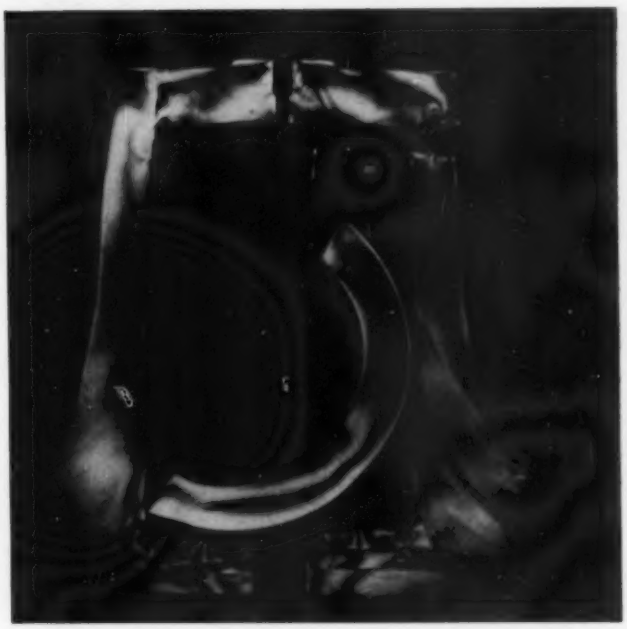


FIGURE 2—Slice showing fringe pattern along longitudinal plane through side hole of actuating cylinder of the same large gate valve.

Analysis of Frozen Stresses Will Bring Better Valves, Piping

Make a plastic model, heat and stress it, then cool it to freeze in the stress patterns which can then be analyzed

By Dr. F. C. Monkman, Director of Research and Engineering

and A. C. Thompson, Development Engineer
Walworth Company, New York City

THREE DIMENSIONAL PHOTOELASTICITY provides the best means of analyzing stresses in complex shapes. This particularly applies to valves.

The method is simple: make a plastic model of the valve or shape to be tested, heat it to a critical temperature and stress it. Then, keeping it under stress, slowly cool it and then examine the shape under polarized light to find the stresses. Once the model has been frozen, it can be sliced up and the stresses examined minutely.

Because of the complex shapes which have been incorporated in most valve designs, theoretical prediction of stress distributions is hopelessly complex. Yet, the need to determine these stress distributions accurately is becoming more important. By finding the stresses due to internal pressure, seating forces and piping loads, distortions which may cause improper valve operation may be eliminated by redesign. Thus, a better knowledge of the location of high stress concentrations in valve configurations should result in a better designed, higher quality and more economical product. Of the numerous techniques for experimental stress analysis, photoelasticity seems to offer most promise because it permits visualization of the stress patterns within a valve component.

Too, it gives accurate values of stress over the entire surface of the part. It is particularly useful in finding points of stress concentration.

PHOTOELASTICITY HISTORY

The discovery of the photoelastic effect is credited to Sir David Brewster, who in 1816, published an account of his finding that clear stressed glass when examined in polarized light exhibited colored patterns. Since the possibility of valuable engineering applications was not immediately recognized, however, few practical problems were investigated by means of photoelasticity prior to 1900. Investigators such as Neumann, Maxwell, Wertheim and other noted physicists, nevertheless, developed the under-

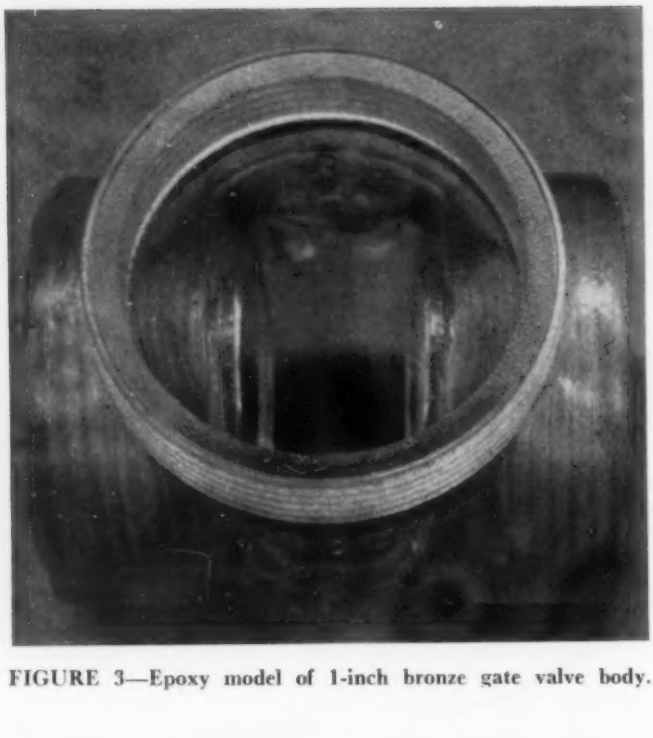


FIGURE 3—Epoxy model of 1-inch bronze gate valve body.

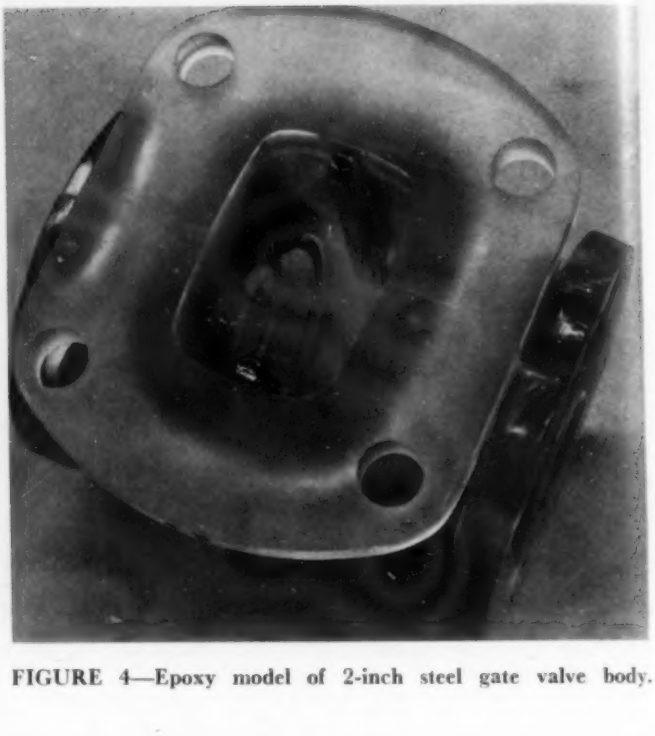


FIGURE 4—Epoxy model of 2-inch steel gate valve body.

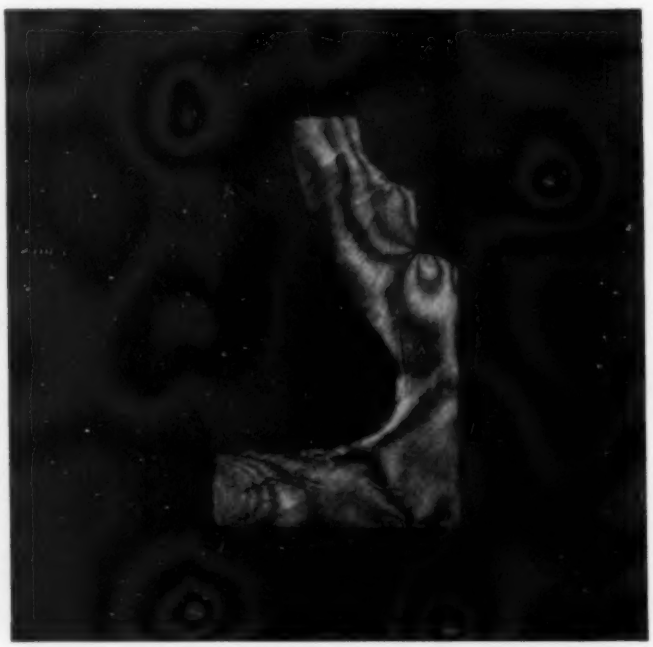


FIGURE 5—Slice showing fringe pattern along transverse axis at side of the same 2-inch gate valve body (dark field).

FIGURE 6—Slice showing fringe pattern along longitudinal axis at reinforcing web between top flange and end flange of lubricated plug valve body (dark field).

lying theory and formulated the concept that the optical retardation producing the color effects is proportional to the difference of the principal stresses existing in the glass.

Prof. E. G. Coker, of the University of London, perhaps the most outstanding of the investigators, developed many of the techniques which have made engineering applications of photoelasticity possible. His introduction of celluloid models and monochromatic light have led to the modern methods which make photoelasticity a powerful tool.

In recent years, the engineer has been able to expand the use of the method through the development of new synthetic resins. In addition, the development of inexpensive plastic material capable of polarizing light and analyzing polarized light has resulted in the use of larger fields of view and reasonably sized models.

TWO-DIMENSIONAL PHOTOELASTICITY

The two-dimensional method can readily be applied to problems where the stresses act essentially in one plane. A model of the actual member is made from a special

transparent plastic, and then, while polarized light is projected through it, the model is subjected to external loading. Alterations in the light transmission properties of the material caused by strain are manifested in interference bands or fringes. The fringes are counted, and the stresses in the model are computed by correlating the results with those obtained from standard specimens such as a simple beam or a tensile model.

THREE-DIMENSIONAL PHOTOELASTICITY

Because of greater experimental difficulties, the potential of the three-dimensional technique has not been fully realized. Until recently, one of the major problems in three-dimensional photoelasticity has been the lack of a suitable material which would not only exhibit the desired photoelastic properties but also would be consistent and would have a minimum of residual stresses.

The introduction of phthalic anhydride-cured epoxy resins in the last few years, however, has apparently provided such a material. This class of plastics can be cast readily in any size or shape, and because of their adhesive properties, pieces can be cemented together to simulate welded prototypes or to facilitate the making of the models.

In the three-dimensional or "frozen-stress" method of photoelastic analysis, the model is heated slowly to a specific temperature, known as the critical temperature, loaded with internal pressure or some other type of loading as the case may be, then slowly cooled to room temperature, and the loads removed. Such a procedure locks or "freezes" the stress pattern into the model. Thin slices taken from the model at certain important points such as planes of symmetry or known principal planes, are then examined in polarized light and the problem becomes essentially two-dimensional. Careful slicing will not disturb the locked-in stress pattern.

APPLICATION ON VALVES

The major problem in the application of the techniques to valve configurations is that it is difficult to cast stress-free models of the rather complicated shapes. Up to recently, three-dimensional models have been machined from simple shapes which can be obtained commercially. Recently, methods of casting reasonably stress-free models of epoxy resins suitable for photoelastic analysis have been developed. This is an important contribution to three-dimensional photoelasticity.

In addition, our research team has evolved techniques for making stress-free cylindrical castings of epoxy and for applying photoelastic methods to simple shapes representative of valve configurations. Pressure stresses have been "frozen" into a quarter size model of the actuating cylinder of a large nuclear gate valve (Figure 1) and the model sliced without disturbing the stress pattern (Figure 2).

RESULTS OF TESTS

Models of the bodies of the 1-inch bronze gate valve and the 2-inch cast iron lubricated plug and cast steel gate valves (Figure 3 and 4) have been pressurized, "stress-frozen," and sliced along planes of symmetry. Typical slices, showing the fringe patterns when viewed in polarized light, are shown in Figures 5 through 9.

When slices are treated two-dimensionally, methods are available for determining the stresses at the inner and outer surfaces of the valve body, while other methods, too involved for this presentation, are applicable for finding the interior stresses within the valve body. In practice, however, a knowledge of the boundary stresses generally provides sufficient information for satisfactory solution of most design problems.

As mentioned previously and as shown in the photographs, with monochromatic light the fringe patterns consist of a set of alternately dark and light bands. Each fringe is the focus of points of constant difference in principal stresses. The principal stress difference is a linear function of the fringe order. The fringe order n is related to the principal stress difference by the following equation:

$$\sigma_1 - \sigma_2 = \frac{n\,f}{t}$$

Where σ_1 = algebraically larger principal stress, psi.

σ_2 = algebraically smaller principal stress, psi.

n = order of interference or fringe order.

f = material fringe constant or optical constant.

t = thickness of model, inches (in direction of light).

At the boundary, the maximum principal stress σ_1, lies parallel to the boundary and the minimum stress σ_2 is normal to the boundary. On the outer surface of the valve body, where no external load is applied, the σ_2 stress is zero, while on the inner surface, where the pressure is applied, the σ_2 stress is a compressive stress numerically equal to the pressure. Thus, when the fringe constant is obtained by finding a zero order (with white light and dark background, this is black surrounded with orange tints) and counting fringes from it, the principal stresses on the boundaries can be found.

Now, as long as the photoelastic model and its metal prototype are geometrically similar, the law of similarity may be applied to two-dimensional cases as follows:

$$\sigma_p = \sigma_m \left(\frac{W_p}{W_m}\right)\left(\frac{t_m}{t_p}\right)\left(\frac{l_m}{l_p}\right)$$

where the suffix "p" refers to the prototype, and "m" to the model, and

σ = stress at a given point.

W = applied load.

t = thickness.

l = a typical length dimension.

Thus, in summary, the stresses in the model are obtained by determining the fringe constant, the fringe order (by means of a circular polariscope with monochromatic light) and the thickness of the model (or slice). The stresses in the metal prototype are then found by the use of the similarity law given above.

Thus far, excellent agreement has been found between pressure stresses obtained photoelastically and those ob-

FIGURE 7—Slice showing pattern along longitudinal axis at side of 2-inch lubricated plug valve body (dark field).

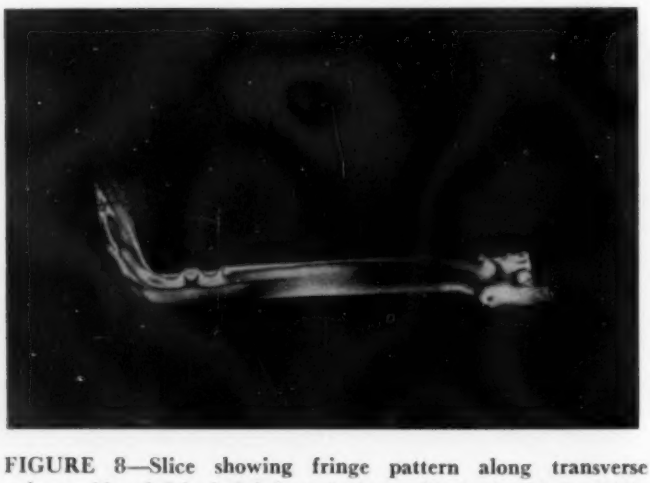


FIGURE 8—Slice showing fringe pattern along transverse axis at side of 2-inch lubricated plug valve body (dark field).

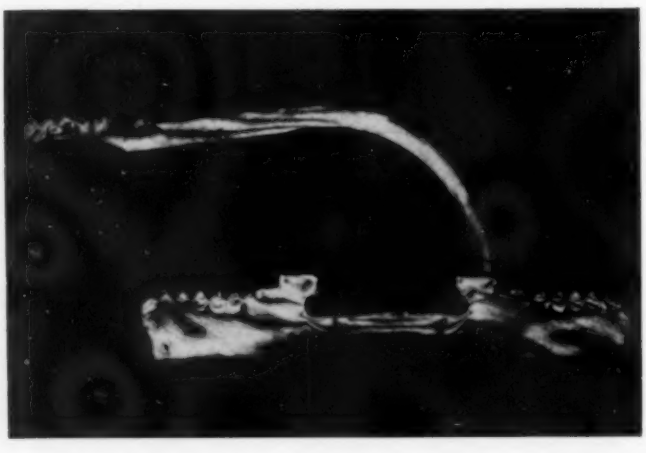


FIGURE 9—Slices showing fringe patterns along transverse and longitudinal axis at side of 1-inch gate valve (dark field).

About the Authors

Monkman

Dr. Forest C. Monkman is the director of Research and Engineering for the Walworth Company. Dr. Monkman received his S.B., S.M. and D.Sc. degrees from the Massachusetts Institute of Technology, specializing in the field of high temperature metallurgy. Prior to joining Walworth in 1955, he was manager of the New England Materials Laboratory. Dr. Monkman is a member of Sigma Xi, ASME, ASTM, ASM and AIME.

Thompson

Alfred C. Thompson is a development engineer in the Research and Product Development Division of Walworth where he is investigating stresses in valve configurations and developing new valve designs. He received a S.B. from Massachusetts Institute of Technology in 1947, and an S.M. degree in mechanical engineering from Northeastern in 1956. In 1959, he completed the Modern Business Course of the Alexander Hamilton Institute. In between studies he worked as a sales engineer and as a research engineer with MIT and as a senior mechanical engineer with Arthur D. Little, Inc. Prior to joining Walworth in 1957, he worked on the design of industrial conveyors at the Norfolk Iron Co.

tained from strain gages on cylindrical sections where gages are satisfactory. In other areas, the stress concentrations have been well delineated by the fringe patterns. Continued efforts to perfect experimental techniques and to extend the techniques to combinations of internal pressure, seating forces and piping loads are being made.

EXPECTED BENEFITS

This appears to be a technical break-through in the analysis of stresses in complex shapes which to date have defied calculation or analysis by other experimental techniques. It is believed that the three major causes of excessive stresses and distortions in values—pressure, seating forces and line (bending) loads—can be successfully investigated by three-dimensional photoelasticity. Once the relationships between these loadings and the stresses are determined for several basic configurations, the current time-proven designs can be modified for greater strength and, perhaps, cost savings. The new concepts in design will result in one or more of the following: saving of material, more efficient use of material and increased ratings. Through these advances in research, we hope to be able to develop more economical, as well as higher quality valves, thus promising reduced construction and maintenance costs for power, pipe line and other industries. —The End

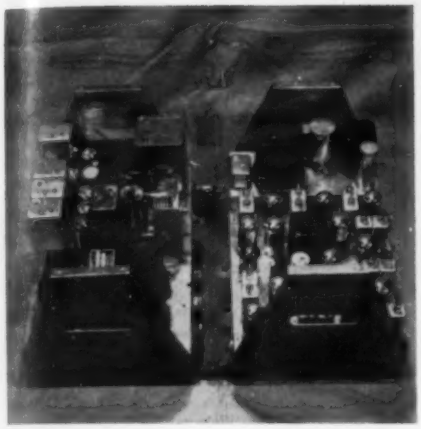


FIGURE 1—Two-drawer mobile transmitter and receiver using dynamotor power supply.

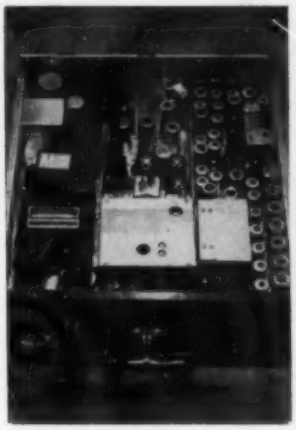


FIGURE 2—Single-drawer mobile unit with dynamotor/vibrator power supply.

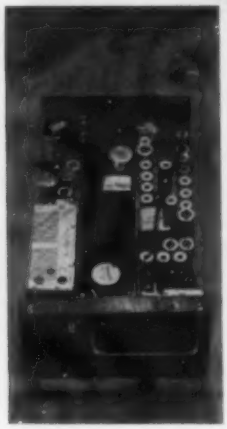


FIGURE 3—Single-drawer mobile unit with vibrator power supply.

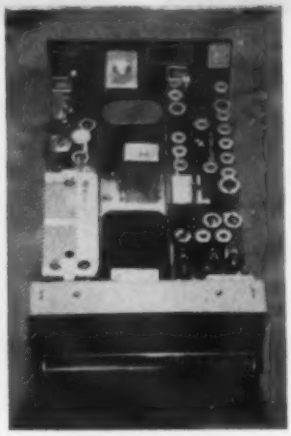


FIGURE 4—Mobile unit with transistor power supply.

New and Unusual Ideas In Mobile Radio

By J. O. Mostrom
Manager Electrical and Communications Branch, Engineering Dept. Phillips Petroleum Co., Bartlesville, Okla.

NEW DEVELOPMENTS are coming thick and fast in radio operations and equipment. Ever since World War II the sky has been the limit so far as new ideas have been concerned—with these three restrictions:

1. The operational limits of the equipment must not be exceeded.
2. The possibility of interference with others must be minimized.
3. The Rules and Regulations contained in the Communications Act and administered by the Federal Communications Commission must be followed strictly.

Sometimes special applications of radio require modification of licenses or special authority to operate. This should be investigated very carefully before anything other than a simple, straight-forward base or mobile operation is attempted. Phillips has consistently maintained a policy of complying strictly with FCC requirements, even though additional cost and inconvenience are sometimes involved.

Here are some of the recent innovations in Phillips' radio operations and an outline of the benefits each one has provided. The first two are advances in manufacturing. Others are attempts on our part to meet specific needs by adaptation of conventional equipment. It should be recognized that not every user has the same requirements. Consequently, these ideas may not be useful to others except to stir the imagination and possibly suggest similar arrangements that would be useful.

We do not claim originality or exclusiveness in any of these ideas. Perhaps some of you are even now using one or more of them.

Transistorized Equipment. The transistor has shown itself to be a very rugged and reliable device under ordinary conditions. Manufacturers of mobile radio wasted no no time designing equipment to incorporate it. Almost everyone agrees, however, that wholesale conversion from

Here Are Important Innovations . . .

1. Base Station Operation Through a PBX.
2. Intercom and Radio Combined.
3. Economy Style Weatherproof Base Station.
4. Handy Talkie with Loud Speaker.
5. Transistorized Amplifier for External Loud Speaker.
6. Emergency Power Supply for Remote Consoles.
7. "Poor Boy" Remote Control Console.

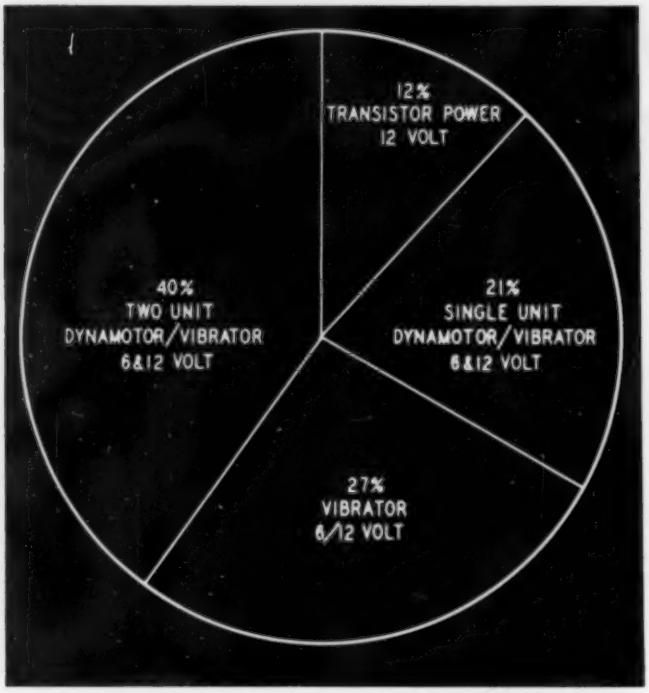


FIGURE 5—Comparison of maintenance costs of the four units.

vacuum tubes to transistors is not yet indicated. Generally speaking, transistorized equipment is higher in price and only recently have transistors been developed which begin to approach the vacuum tube in frequency range, power handling ability and effect of extreme temperatures.

We have been particularly impressed with the use of transistors in the power supplies of mobile radio units. This has done away with the sometimes troublesome mechanical vibrator and materially reduced maintenance costs. Units having such power supplies cost about 10 percent more than conventional units but we have found that this extra cost is quickly recaptured in reduced maintenance costs. In a recent study, four different types of units were observed over a 12-month period:

1. Two-drawer, dynamotor, 20 units, Figure 1.
2. Single-drawer, dynamotor/vibrator, 20 units, Figure 2.
3. Single-drawer, vibrator, 20 units, Figure 3.
4. Transistorized power supply, 20 units, Figure 4.

Figure 5 shows, graphically, the comparative maintenance costs on each of the four types.

Manufacturers are now offering radio units in which the receiver is completely transistorized and the transmitter, partially. These are more expensive, however, and we believe that payout of the extra cost over those having transistorized power supplies only is marginal. They should effect even lower maintenance costs, however, and should be ideal for remote and isolated locations where service and maintenance is a very important problem.

Our present policy, generally, is to purchase any new units with transistorized power supplies only. These are placed in our more remote locations and the older, conventional units are moved to locations where maintenance facilities are readily available.

New, Smaller Antennas for 30 MC. Mobile antennas for the 30 MC region have always been a problem. They have had at least two major mechanical shortcomings:

1. They have been quite long and unwieldy and thus created hazards to any low hanging objects under which the vehicle might pass. They themselves, suffered a high mortality rate from contact with such objects.
2. Because they are long and heavy, their mounting hardware is necessarily quite rugged. This requires a large hole in the body of the vehicle and several small ones. These holes are difficult and costly to fill and refinish when the time comes to dispose of the vehicle. This is doubly important to Phillips because most Phillips vehicles are rented and the rental agency demands complete repair of the body.

Several antenna manufacturers are now offering smaller antennas for 30 MC. Admittedly they are a compromise electrically but we have found them more than adequate for many applications. They do effectively minimize the shortcomings of conventional antennas mentioned earlier. Lengths vary from 26 inches to 48 inches and the mounting hole is only $\frac{7}{8}$-inch diameter. Figures 6 to 10 are actual photographs of some of the antennas we have tested. The graphs in Figures 11 and 12 compare with the transmitting and receiving performance, respectively, of these antennas with a conventional quarter wave whip.

We have found that, in many applications, the maximum range of conventional antennas is seldom required. It is in these applications that the new, smaller, antennas can be used to advantage. You have noted on the graphs that the transmitting and receiving patterns are not appreciably different from those of conventional antennas.

Base Station Operation Through a PBX. This application has become one of our most valuable and successful uses of two-way radio. It is now in use at two of our largest and busiest PBX switchboards.

In the past, the greatest deterrent to patching radio calls through a PBX has been the necessity of push-to-talk, single frequency operation. Voice operated relays have now been perfected which can obviate this need. Our approach has been to connect such a voice operated relay controlling the base station transmitter and receiver to a station jack on the switchboard. The only other equipment needed is a monitor speaker which will alert the PBX operators to incoming calls. Figure 13 is a block diagram showing the connection of the equipment and Figure 14 shows a telephone being used to control the radio base station.

This arrangement makes it possible to have contact with mobile units from any local or remote telephone connected to the PBX. Exchange or long distance service, of course, is not allowed since it would be in conflict with common carrier regulations. Anyone desiring to make a base station call merely dials the operator. Figure 15 shows the PBX switchboard where calls are received. If the frequency is idle, the operator connects the caller to the radio and he makes his call in the usual manner. Each time he speaks, his voice "keys" the transmitter and disables the receiver. When he stops speaking, the reverse occurs.

When a mobile unit calls the base station, the PBX operator hears the call through the monitor speaker and answers by plugging her answering cord into the radio

FIGURE 6—Conventional quarter wave whip for 33.38 MC.

FIGURE 7—Roof type, base-loaded antenna.

FIGURE 8—Roof type, base-loaded antenna mounted on rear quarterdeck.

FIGURE 9—Fender type, base-loaded antenna.

FIGURE 10—Helical antenna.

jack. She can then connect the mobile unit with any desired party by telephone.

This arrangement has a number of advantages:

1. Remote control consoles and control lines are no longer needed.
2. Contention between remote operating points is eliminated.
3. The PBX operator can schedule an orderly use of the base station by the various users. She can complete calls on a "filing-time" basis unless emergencies dictate otherwise.
4. More users can have immediate access to the radio.
5. Equipment and maintenance costs are reduced as compared to two or more remote consoles.
6. Air time is conserved. "Impulse" calls are discouraged.

Intercom and Radio Combined. A loud speaker intercom system has come to be regarded as a very useful tool at marine terminals where barges and tankers are loaded and unloaded. Since most locations in such terminals are hazardous, explosion proof equipment is used.

Two-way radio is also very useful. Usually there are one or more vehicles in use which need to be in contact with various operations at the terminal. Since it would be impractical and hazardous to locate remote control consoles at the dock and at the loading rack, the idea was conceived of combining the radio base station control with the intercom. Figure 16 shows the connection in a block diagram.

With this arrangement it is possible to issue a call on the radio and intercom at the same time. Of course, the radio control can be disabled at the office when it is not desired. The office is attended at all times when the terminal is operating. Conversely, a call coming from the mobile unit can be heard by anyone within range of an intercom station. Figure 17 shows the intercom equipment at the loading rack.

This hook-up has been very useful. It has permitted employes at the terminal to be much more mobile during loading or unloading operations. Any employe can be

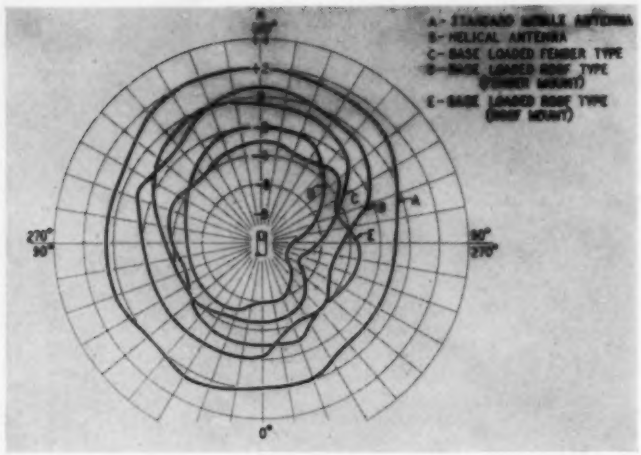


FIGURE 11—Comparison of transmitted signal levels.

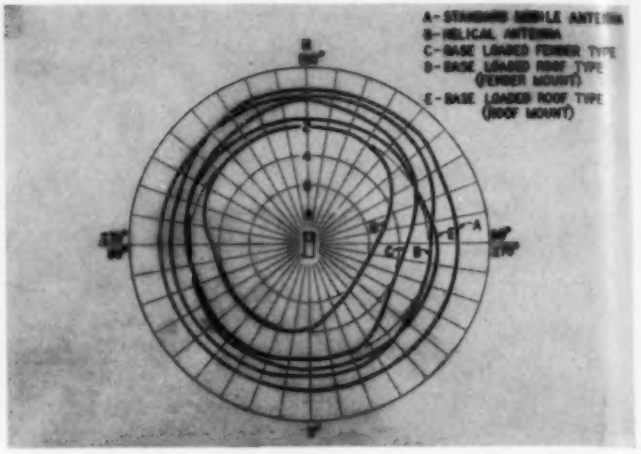

A- STANDARD MOBILE ANTENNA
B- HELICAL ANTENNA
C- BASE LOADED FENDER TYPE
D- BASE LOADED ROOF TYPE (FENDER MOUNT)
E- BASE LOADED ROOF TYPE (ROOF MOUNT)

FIGURE 12—Comparison of received signal levels.

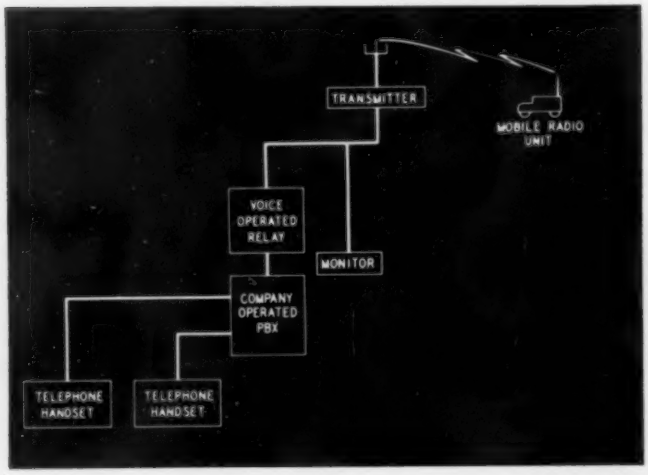


FIGURE 13—Voice-operated keying relay connected to a PBX switchboard.

FIGURE 14—Voice-operated relay in use controlling two-way radio.

reached quickly whether he is stationed at a fixed point or riding in a vehicle. This has contributed greatly to improved safety and efficiency.

Weatherproof Base Station, Economy Style. Figure 18 shows a standard "utility" unit used as a weatherproof base station. The enclosure is a standard mobile unit weatherproof housing. It has been fitted with a blower for ventilation and cooling. The blower is controlled by a thermostat. In practice we have found that the blower operates very little, even in hot weather. A standard adapter kit has been added to the radio unit to provide remote control from the office. As can be seen in Figure 19, the standard control head with microphone and loud speaker is also left in place for local control and testing. This is an inexpensive but very effective way to set up a small base station. It can be achieved for approximately $550, about half the cost of a standard weatherproof base station.

Handy Talkie with Loud Speaker. It is often necessary for the user of a handy talkie to set his radio unit down and leave it while he performs physical work. Such work often takes him beyond earshot of the small speaker in the unit, especially in areas of high noise level. Figure 20 shows an expedient which has served very well under these conditions. Here, a standard weatherproof loud speaker has been mounted on the unit. By means of this

FIGURE 15—PBX switchboard with voice operated relay connected.

unit the operator can be summoned to the unit for exchange of communications or given instructions, as the case may be. This unit has been used to great advantage at tanker loading and unloading docks where the loader must be free to roam over quite a large area. Used in conjunction with the intercom-radio systems described earlier, it again permits greater mobility of personnel.

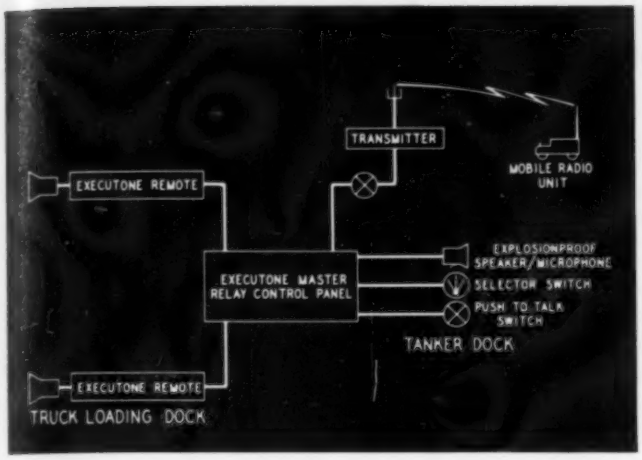


FIGURE 16—Two-way radio and intercom combined at a marine products terminal.

FIGURE 17—Intercom equipment at loading rack.

FIGURE 18—Weatherproof base station using utility unit.

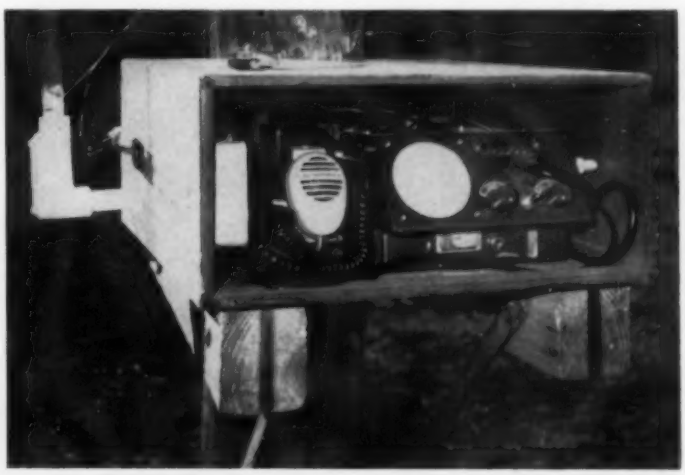


FIGURE 19—Weatherproof base station with cover removed.

Emergency Power Supply for Remote Consoles. Where two-way radio communications are vital to a plant or area during time of emergency, it is important to have stand-by power supplies for the base station equipment. The base station itself usually has access to such supply or can be served by a stand-by engine-generator set. The remote control points, however, are often at scattered locations and require small emergency supplies of their own. Figure 21 shows a DC power supply consisting of a storage battery and rotary converter. An AC trickle charger is also included to insure full battery capacity when it is needed. Figure 22 shows the supply in normal use. This unit is designed to take over automatically when commercial power fails. It has been in service about 8 years. Today's version would probably be transistorized.

Transistorized Amplifier for External Loud Speaker. It is often very helpful to have an extra powerful loud speaker associated with a two-way radio unit. High ambient noise level or remoteness of the crew from the unit are the usual reasons for this requirement. Drilling rigs are outstanding examples of this problem. To provide adequate output for such speakers we have built a number of 12-watt power amplifiers using two power transistors in push-pull. Figure 23 is a top view of one of these units. Figure 24 is a bottom view. Note that the chassis is designed to mount directly on the back of a radio cabinet. The model shown is for AC operation. The DC model for mobile use is smaller because a power supply is not needed. It is powered directly from the battery.

Automatic Cycling Timer. Servicing two-way radio units on a test bench can be very trying. Failures which occur in actual operation often refuse to appear under the ideal conditions of the service shop. Intermittents almost never occur there. To simulate actual operating conditions and even exaggerate them, we have used, with gratifying success, the small timing unit shown in Figure 25 to cycle radio units on the bench. With this timer we can schedule "key-down" conditions either 20 or 40 seconds during each minute for any period we desire. Of course, the transmitter is coupled to a "dummy" load. If trouble is imminent it usually shows up in relatively short order. This has saved many expensive and untimely service calls.

"Poor Boy" Remote Control Console. Handsets for controlling base station radio units have been available for some time. When there is a requirement for a loud speaker, however, the unit becomes somewhat special. Figure 26 shows one approach to this problem. This unit incorporates a "push-to-talk" mobile type microphone, a

FIGURE 20—Handy talkie with weatherproof loud speaker.

FIGURE 21—Emergency power supply for remote control console.

FIGURE 22—Emergency power supply for remote control console in use.

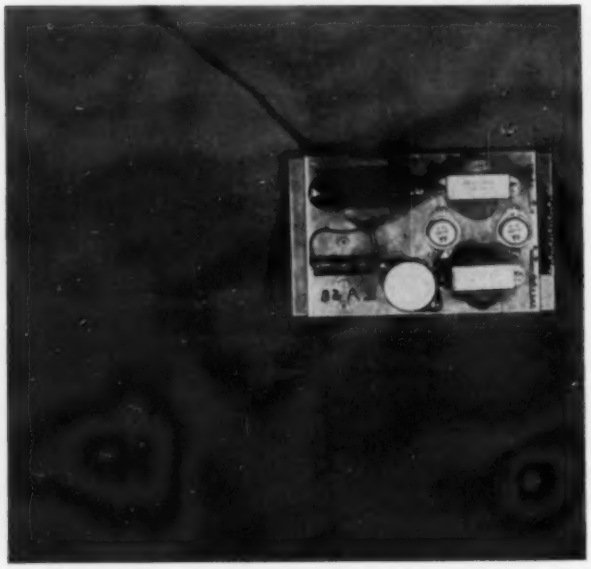


FIGURE 23—Transistor amplifier for external loud speaker on two-way radio unit.

FIGURE 24—Bottom view of transistor amplifier.

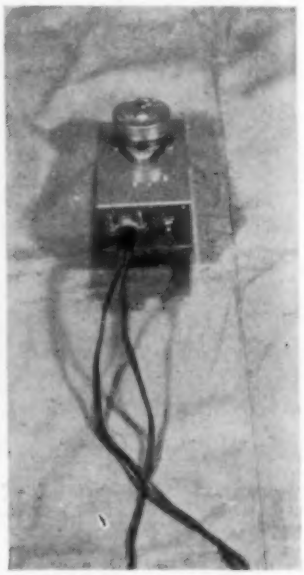


FIGURE 25—Cycling timer for test bench.

About the Author

J. O. Mostrom is manager of the electrical and communications branch, service division, of Phillips Petroleum Company's Engineering Department. He started with Phillips in 1937 in the design division and has held his present position since 1953. He received his B.S. degree in electrical engineering from the University of Nebraska. He is a member of the American Institute of Electrical Engineers, Oklahoma Society of Professional Engineers, American Petroleum Institute and Petroleum Industry Electrical Association.

FIGURE 26—"Poor Boy" remote control console.

loud speaker with an adjustable volume pad and a terminal strip all mounted in a commercially available intercom housing. The whole unit costs about $35. It can be used any place within about a 50-foot radius of a base station or a remote control console.

These and many more ingenious ideas have given radio engineers and technicians a reputation for outstanding resourcefulness. The rapid development of the two-way and mobile radio art can be expected to continue under their leadership and initiative.

ACKNOWLEDGMENT

From a paper presented at Petroleum Industry Electrical Association annual meeting in Kansas City, Mo., 1960.

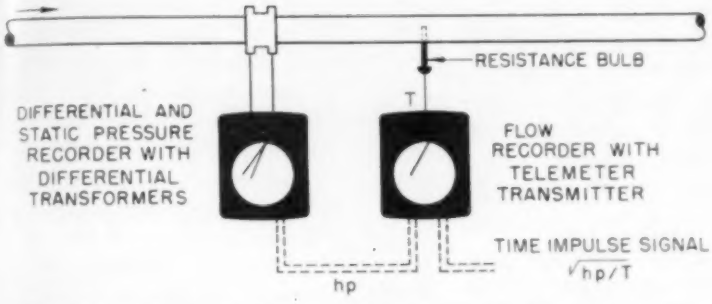


FIGURE 1—Simple single-run station. Conventional flow instrument measures static and differential pressures; small transducers convert them into voltage signals and multiply them together to produce voltage equivalent to hP, which is fed into computer that calculates $\sqrt{hP/T}$ and transmits this information to the central office.

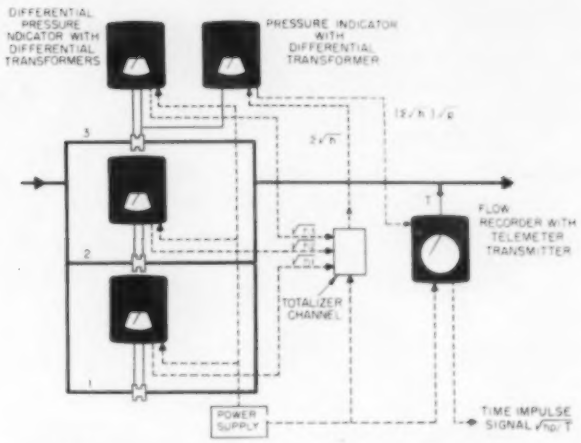


FIGURE 2—Computing system designed for multiple meter run station. Differential pressure indicators on each meter run may be used for both telemetering and billing purposes. Each contains a large square root cam and transmitter. Output voltage is proportional to $\sqrt{h}$ — the differential pressure. The totalizer produces a voltage equivalent to the three square roots of differentials and with $\sqrt{p}$ information is fed into the flow recorder computer along with gas temperature. Computer pen records $\sqrt{hP/T}$ and telemeters it into central station.

Computer Dispatching Is Coming

Advances in telemetering, and remote controls have made the next step toward system control a relatively simple matter

By R. E. Burrell, Manager
Electrical Product Group, The Foxboro Co., Foxboro, Mass.

SEVERAL STUDIES HAVE SHOWN that computer control of pipe lines is definitely practical. Telemetering and remote controls have advanced to the point that a move in this direction will not be long in coming.

In the years since telemetering was introduced, remote measurements of gas flow conditions have been made readily available to many of the gas system dispatchers. The telemetered signal makes it possible for the dispatcher to act more promptly than ever in adjusting flows at either end of the line.

These are steps in the right direction, but improvements in recent instrumentation are bringing opportunities to simplify central office procedures, particularly in minimizing human errors and reducing operating expense.

Three such areas—already proving beneficial in small and large systems alike—are utilization of fewer telemetered signals and channels to provide more complete and more usable information; the automatic calculation of corrected flow at the metering station, and more efficient methods of transmission and remote control.

In practice, this means that the unattended remote metering station is closer to reality. With the new techniques and transmission equipment now being used, there is no longer any need to take manual readings at the remote station and relay them to the central office where computations of corrected flow are made. **Instead, flow can be automatically computed at the station and transmitted as a SINGLE measurement! This measurement can be received as a chart record, as integrated flow on a counter, or can be automatically typed on log sheets.**

Modern transmission equipment makes it possible to transmit a number of signals simultaneously in both directions over a single circuit. This means that control signals can go to the metering station at the same time the corrected flow measurement is being transmitted to the central station. More recently, coded or selective systems have been used for telemetering or supervisory control systems.

How instrumentation of this sort is employed in a single-run station is diagrammed in Figure 1. In this typical arrangement, a conventional flow and pressure instrument measures the static and differential pressures. Previously, these separate values would have been transmitted separately to the central station. Now, however, the measurements are converted by small transducers into voltage signals which vary according to measurement. These voltages are multiplied in the same instrument to produce hP, (static pressure times differential pressure). This value is then fed into an electronic recording computer.

Also fed to the computer is a continuing measurement of gas temperature which the computer combines with the hP signal. The result is a signal which is proportional to hP/T, read on the square root chart directly as gas flow rate. From the computer, $\sqrt{hP/T}$ is transmitted to the dispatching office by a telemetering instrument with a square root cam so the dispatcher can have a temperature and pressure corrected reading of flow on a uniform chart.

A computing system designed for a multiple meter run station is shown in Figures 2 and 3. While these drawings illustrate an arrangement for a three-run operation, the two- or four-run station would be similarly instrumented.

The differential pressure indicator shown on each of the meter runs in Figure 2 may be added to the basic orifice meter equipment already installed for billing purposes, or may be used for both telemetering and billing purposes. These indicators each contain a large square root cam and a transmitter.

The ouput is a voltage proportional to the square root of the differential pressure ($\sqrt{h}$). A totalizing unit sums these voltages, producing an output proportional to the sum of the $\sqrt{h}$ values. Receiving this totalizer output is a pressure indicator which also has a square root cam and a transmitter. Its output—the product of ($\sqrt{h_1} + \sqrt{h_2} + \sqrt{h_3}$) and $\sqrt{p}$—is fed to a flow recorder computer, along with the resistance bulb measurement of gas temperature. The computer pen then records $\sqrt{hP/T}$, which can also be telemetered back to the central station.

There are other factors, of course, which enter into the calculation of corrected flow. Suppose, for instance, that each of the meter runs has an orifice plate of a different size. In this case, the output voltages from each run to the totalizing channel must be weighted in proportion to the orifice factors of each plate. This is done by using simple voltage divider circuits to take care of orifice plate differences. It is also possible to incorporate manually set corrections in the circuit to compensate for specific gravity and supercompressibility. Additionally, the basic orifice factor adjustment can be introduced ahead of the flow recorder computer, producing a chart record reading directly in units of flow.

On the other hand, if a system is balanced, it then becomes possible to compute the flow through *one* run and multiply by the *total* runs in use. The system for accomplishing this, illustrated in Figure 4, works essentially the same as the multiple run system shown in Figures 2 and 3, with one exception: instead of using a totalizer to add the $\sqrt{h}$ values from each run, the flow recorder computer is equipped with a voltage divider circuit actuated by valve contacts. These contacts indicate which runs are in or out of service, enabling the computer to read total station flow, corrected for the number of runs in operation.

A typical panel-mounted gas flow computing system—completely factory-built, calibrated and ready for installation—is shown in Figure 5. This system, which can be supplied as a "package" unit, enables the instrument manufacturer to simulate field conditions in his plant and to check system operation before shipment. In this way, much of the field work is eliminated. Also, since an integrated system is supplied, accuracy can be guaranteed.

There is no question that recent advances in telemetering and super-

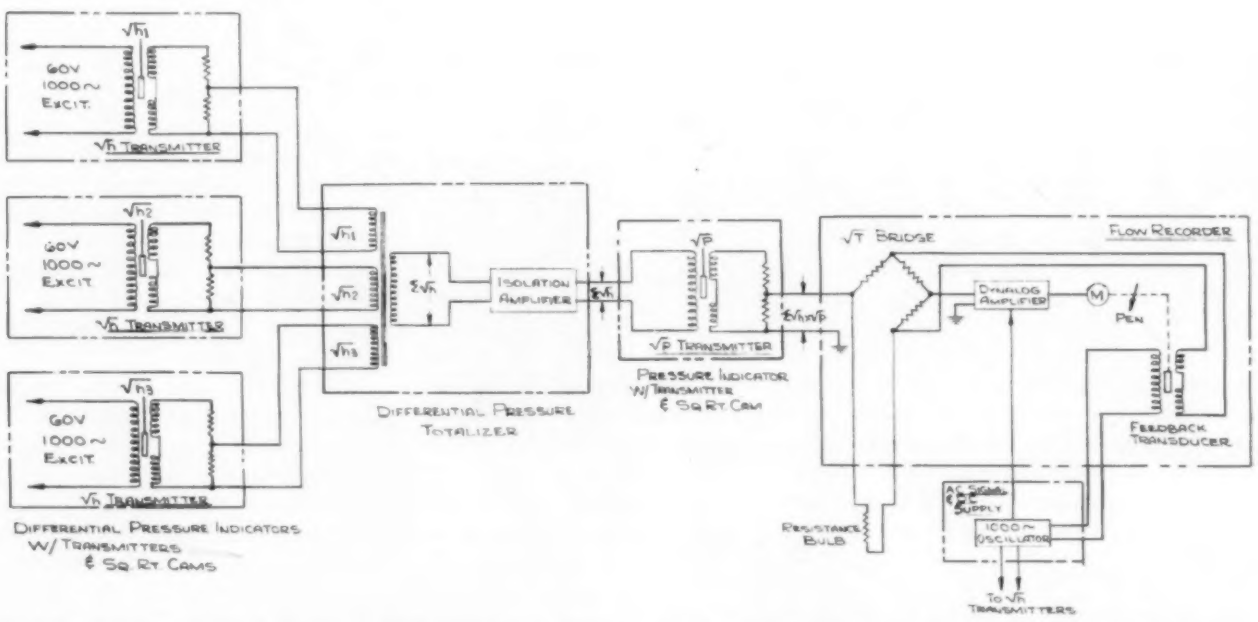


FIGURE 3—Schematic of the instrument hookup shown in Figure 2. If the orifice plates in the three meter runs are different, the output voltages to the totalizer must be weighted in proportion to the orifice factors of each plate. This is done by using simple voltage divider circuits. It is also possible to incorporate manually set corrections in the circuit to compensate for specific gravity and super compressibility.

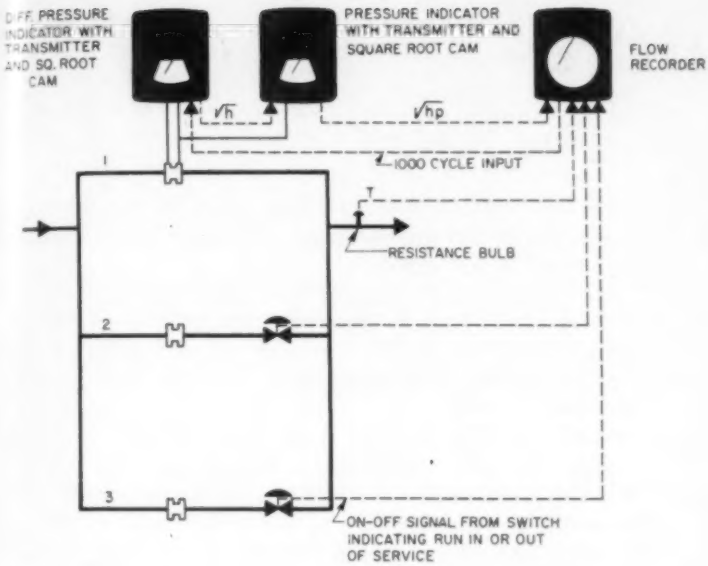


FIGURE 4—If a system is balanced, it is possible to compute the flow through one run and multiply it by the total runs in use. Instead of a totalizer to add $\sqrt{h}$ values for each run, the computer is equipped with a voltage divider actuated by valve contacts, which indicate which runs are out of service.

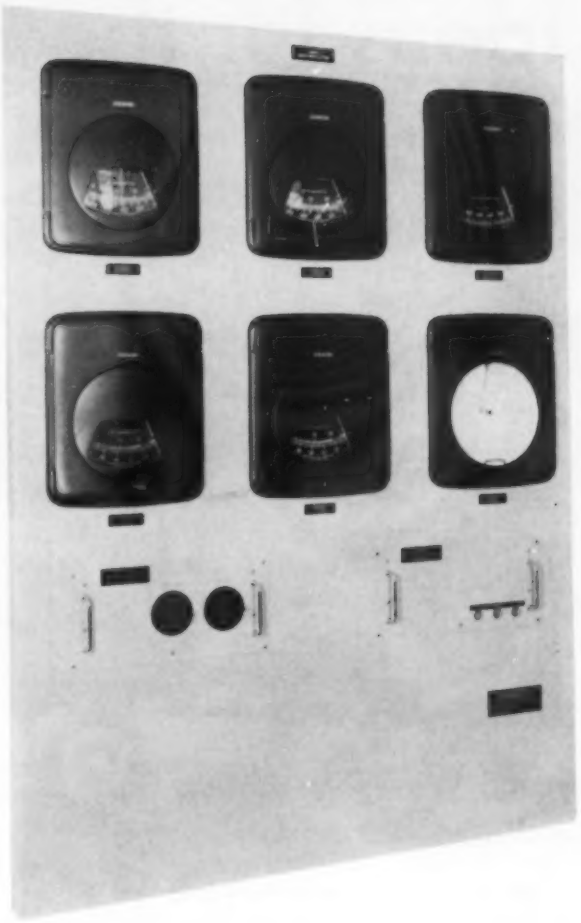


FIGURE 5—Typical panel-mounted gas flow computing system. This is factory assembled and tested, prior to shipment to the field.

visory control coding and multiplexing techniques have contributed importantly to present day centralized control of gas dispatching. Modern electronic measurement and control systems also have made possible more reliable operation, faster response and have greatly simplified installation and maintenance procedures. In addition, electronic equipment has eliminated many mechanical operations in multiplying, extracting square root and other computing functions. Coupled with routine functions such as recording, indicating and controlling, integrated electronic systems can provide automatic logging of variables, with off-normal indication and all other requirements of a complete logging system.

Future designs. What is left to be done? One of the most significant improvements in system control and operation could result from the use of digital computers at the central office. Ideally, information transmitted from metering stations and local control points could be fed into a central computer which, in turn, would initiate control functions throughout the system on a predetermined program. The dispatcher could then devote more time to improving system operation and be forewarned of trouble far enough in advance to prevent, rather than correct it.

Already, studies have been made by a number of groups working independently on the feasibility of computer control of pipe lines. Many of the larger pipe line companies are either contributing to or taking an active part in these studies. Findings so far indicate that computer control is definitely practical. However, further study is necessary to evaluate all the factors involved in bringing an entire system under computer control.

From these recent developments and those to come, one thing is certain: still better control of gas transmission and distribution systems than is now possible. We are witnessing only the beginning stages of the progress which will be made over the next few years toward utilization of fully automatic operation. —**The End**

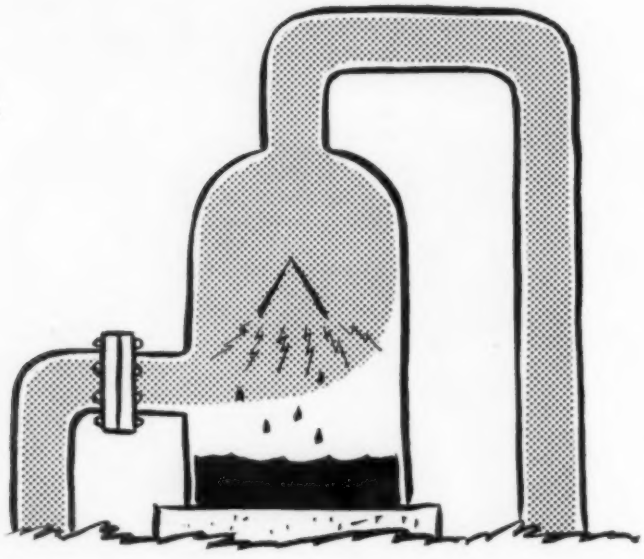
About the Author

Robert E. Burrell has been with The Foxboro Company for 10 years. He has had duties ranging from research, co-ordinating factory engineering, sales of electrical products to his present job as manager of the company's Electrical Product Group.

Burrell is a graduate of M.I.T. with a degree in Electrical Engineering. He served 2½ years in the U. S. Air Force as an airborne radio operator. A number of his papers on telemetering and supervisory control have been presented before technical groups and appeared in engineering magazines.

Ideas for the Future

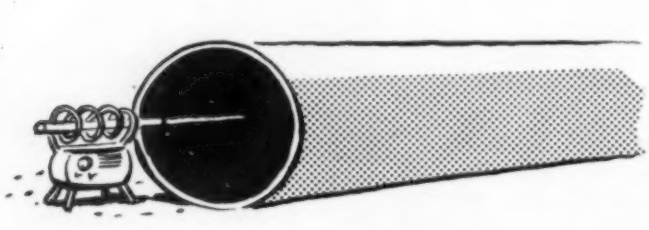
By Donald M. Taylor, Engineering Editor



Sound Waves Precipitate Dust and Mist; Act As Dryer

The uses of high intensity sound are only beginning. At New York University, Dr. Raymond M. G. Boucher is directing work seeking to develop a new type of dust and mist precipitator. The precipitator is based on the use of a strong sonic radiation pressure combined with mesh arrestors. This could result in improved scrubbers.

Dr. Boucher's group is also investigating the drying of powdered food-stuffs and organic compounds by means of sound. A small-scale sonic dryer is already under test.



Soon We'll Be Pipelining Light! (10 Million TV Channels per Band)

The time may not be far off when we will be pipelining light!

Thanks to optical masers (Microwave Amplification by Stimulated Emission of Radiation) we may one day have optical communications systems which will carry 10,000,000 simultaneous TV channels on a single 1-A bandwidth.

The maser is a synthetic ruby crystal which absorbs energy over a broad band of frequencies and radiates the energy in a very narrow band of frequencies. The emitted light is monochromatic and duplicating its intensity with conventional light sources, would require temperatures of several billion degrees.

The intensity of the light from the optical maser is a million times brighter than the sun! The cone of the emitted light has a spread of only $\frac{1}{20}$ of a degree and it can be focused to a diameter of 15 to 30 millionths of an inch.

While Hughes Aircraft is the inventor of the optical maser, the latest development comes from the laboratories of IBM, which has announced a new maser composed of calcium fluoride crystals containing one percent uranium or samarium ions. These crystals will concentrate light in a highly directional beam and the waves it generates are continuous. In this latter respect, it differs from synthetic ruby masers.

Why pipe line this light? Primarily, to prevent attenuation of signals by fog and dust. Expensive as this seems, the advantage of the almost limitless spectrum, which will be available for communications, far overrides the cost of pipelining.

Breakthrough in Electronics! – Ultra Low Noise Amplifier

The greatest need in radio and radar is a low-noise amplifier. The reason? It is the unwanted noise in electronic equipment that sets the limit on how weak a signal a radio receiver will detect. For instance, great amplification of a miniscule signal current is usually thwarted by noise generated by the amplifier itself.

Stanford Research Institute recently took a long stride ahead in this field. Stanford scientists have come up with a single diode, low-noise amplifier which is simple, sturdy and has wide frequency bandwidths. By using circuits employing several diodes, they have extended the frequencies to almost any desirable range.

Here's the way the new method of amplification works: Amplification energy is introduced into the circuit twice per cycle in much the same manner a child "pumps" a swing each time it passes through the zero position. This is done by applying a voltage at twice the signal frequency to a diode capacitor. The resulting noise level is far below any present-day circuits.

Stanford scientists point out that the same effect may

likely be obtained by varying the magnetization of a ferrimagnetic "pumping" element instead of varying the capacitance of the diode.

These low-noise circuits may mean that forward scattering can become feasible for our microwave systems.

Metal or Glass Can Be Used for O-Rings, Flexible Hose

Non-elastomeric materials such as glass, metal or ceramics can be substituted for elastomeric materials such as rubber, etc. says a new U.S. Navy research report. Tests showed that inorganic materials with high temperature serviceability can be substituted for rubber or other elastomeric materials where gross mechanical design allows the materials to be functional. However, the report points out that the non-elastomeric materials must first be fabricated into a form with enhanced flexibility or elasticity—such as a spring, thin sheet, fiber, etc.

Nuclear Engine for Jet Aircraft

A nuclear engine in the form of 150 thirteen-pound cartridges will soon be tried out as an aircraft propulsion unit. The individual cartridges are made of 93 percent uranium dioxide in a nickel-chrome matrix, encased in a beryllium reflector. Hydrated zirconium serves as moderator. General Electric developed the new propulsion system in conjunction with the Air Force and Atomic Energy Commission.

Atomic Rocket Engines Under Test

An atomic rocket engine ran at full power for 15 minutes recently at Mercury, Nev., promising greater things ahead. The Kiwi-A utilizes the pressure increase achieved by shooting gaseous hydrogen through an intensely hot atomic-power generator. A new engine—Kiwi-B—will likely develop three times the thrust Kiwi-A by substituting liquid hydrogen for the gas.

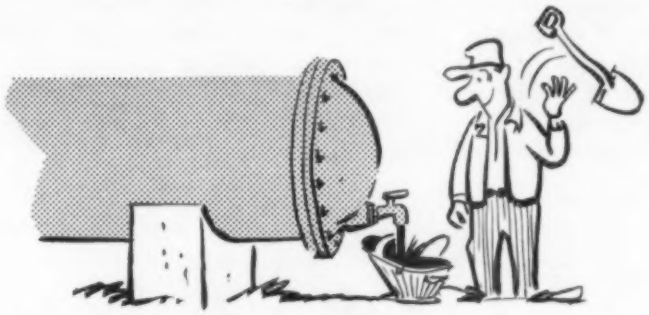
Tough New Coating May Be Best Yet for Pipe Lines

The new urethane coating just emerging from our laboratories as a coating for shoes and golf balls holds promise in the field of pipe coating. It is now undergoing tests for possible pipe line uses.

Characteristics of urethane coatings are:

1. More abrasion resistant than any other known organic coating.
2. They can be made stiff or flexible as desired.
3. Electrical qualities are regarded as excellent.
4. Temperature range —50° to 350° F.
5. Resistance to ultra-violet light—questionable now.

Meanwhile, you will soon be able to buy urethane leather shoes that wear seven times as long as regular shoes and coated golf balls with covers that will probably outlast the golf ball itself!

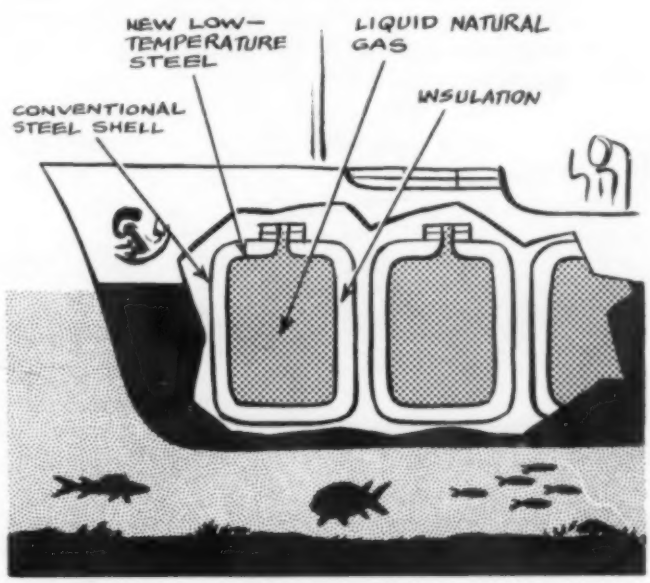


New Method of Liquefying Coal Makes It Behave Just Like Oil

When coal is ground fine enough and mixed into a slurry with water, it behaves just like fuel oil! It can be pipelined without fear of bridging when the operation is halted, and it can be burned in modified oil burners without de-watering.

This has motivated at least one gas company to consider a coal pipe line venture. Texas Eastern Transmission Co. and Consolidation Coal Company are mulling over plans for a 350-mile, 24-inch line from West Virginia to New York to take advantage of the new technique. Cost of the proposed project would be $125 million.

Consolidation Coal Co. has been operating a 108-mile, 10-inch line in Ohio since 1957. Until now, the chief disadvantage of the process has been that the coal must be de-watered before use. But engineers think finer grinding can eliminate this step entirely. Moreover, the extremely fine coal particles will not separate from water even during long stoppages.



Low-Temp Steel Designed for Liquefied Natural Gas

U.S. Steel, International Nickel and Chicago Bridge and Iron have developed a new steel which has low-temperature qualities designed for handling liquefied

natural gas. The nine percent nickel-steel alloy retains excellent psysical qualities down to —35° F, and its price brings it within the economic range needed for tankage of low-temperature natural gas (—260° F).

According to developers, such a storage tank would have two shells—the inner one made of the new nickel steel, the outer shell from conventional steel plate. Insulation between the two would protect the outer shell from low temperature embrittlement.

Discovery:
New Way to Generate Electricity

An iron bar coated with vitreous enamel and a thin silver film will generate current when it is heated. This is unlike other means of thermoelectric generators—based on thermocouple junctions—in that no temperature differential is required. The silvered surface will give off up to 16 milliwatts per square foot when heated between 400° and 1,500° F.

New Tool for High Speed Crack Propagation Studies at NYU

Studies of high-speed crack propagation may soon bring us better understanding of this devastating phenomenon that has wrecked miles of natural gas pipe lines in the past. At New York University, Dr. Rointan F. Bunshah is directing study of phenomena in metals at sonic speeds. For this purpose his group is constructing an ultra high-speed microscopic photographic camera which can show behavior of metals during brittle fracturing and plastic deformation.

Eliminating Conference 'Butt-In'

A new speakerphone system for multi-microphone conferences has politeness built into it, according to L. R. Huggler of the Bell Telephone Co., speaking at the fall meeting of AIEE. The system has "transmit lock out" and "receive lock out" designed into it, and to interrupt one speaker you must wait until he pauses.

(This could all but cripple the API annual pipe line conference where heated interruptions in the past have been the spice of the meeting.)

Longer Lasting Fence Posts

Pipe line companies have bought many a fence post to close gaps along the right of way. When they rot out, the cost of replacement is considerably higher than the original cost.

But a properly treated post will last 30 years or longer, so what's the hitch? Trouble in the past, it seems, is that there have been no comprehensive standards for treating with the result that the consumer has been buying blind, so-to-speak.

A remedy for this situation was recently supplied by the U.S. Department of Commerce. Its publication, CS235-61, covers standards for fence-post treating, and as a result, you will be able to know what you are buying in the future.

Bargain Sources of Technical Information

If all our government departments were run as efficiently as the U.S. Department of Commerce, I wouldn't worry about Russia, taxes and foreign aid. This is a no-nonsense outfit that operates on the theory that the purpose of a government agency is to *serve* the citizenry.

My dealings with the USDC are through Mrs. Louise Clayton, business analyst in the Houston field office in the Scanlan Building. Her loyalty to her organization rivals that of a junior high cheer leader.

Among other duties, she gives the once over to incoming publications, which include all technical reports released by our government-sponsored research and the patent department as well. Occasionally, when she spots an item she thinks may be of interest to pipeliners, she notifies me. All she asks for her trouble is that I give proper credit to USDC. When I hold up my end of the bargain, she's pleased as all get out. When I fail to give proper credit she's peeved. (She checks upon me through the department's office copy.)

Here are two items she recently called to my attention which point up the rich store of information the Depart-

ment of Commerce has made available to industry.

1. **Directory of National Associations of Businessmen**—50¢. This includes the address, secretary, etc. of some 2,000 associations ranging from API to the Zirconium Association. The information available through these associations (including 100 engineering societies) is almost fantastic.

2. **Handbook of Precision Measurement and Calibration** which is being released in three volumes by the National Bureau of Standards. They cover precision measurement and calibration of standards as follows:

Vol. I—Electricity and Electronics (845 pages—$6.00)

Vol. II—Heat and Mechanics (965 pages $6.75)

Vol. III—Optics, Meteorology and Radiation (1025 pages $7.00)

These can be ordered through any USDC field offices.

More Aluminum-Iron Alloys In the Future

Iron-aluminum alloys have excellent oxidation and corrosion resistance; moreover, an investigation of aluminum activities in a number of iron-aluminum alloys have shown a strong negative deviation from Raoult's law—indicating strong bonding. These promising facts were established thanks to a new method of measuring activities and other thermodynamic properties developed at New York University under the direction of Prof. Kurt L. Komarek. Nickel-aluminum and cobalt-aluminum alloys are also being studied.

Making Better Aluminum Pipe

By introducing carbon tetrachloride into an aluminum melt by means of nitrogen gas, the crystals in aluminum-magnesium alloys are finer grained, and the alloys physical properties are improved. Small amounts of titanium and boron must be present in the alloys.

Japanese Are Making Sugar From Sawdust

By modifying an old German process, Japanese scientists have developed a process for extracting sugar from sawdust of ordinary trees. The pilot plant operation looks good according to developer, Shin Nippon Chisso Hiryo Co. The process is based on repeatedly treating the sawdust with hydrochloric acid of different concentrations and temperatures.

Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

$25 for Engineering Data Sheet $15 for Rule of Thumb

These practical aids give quick, reasonably accurate answers to design, maintenance and cost estimating problems. PIPE LINE INDUSTRY will pay $25 for each chart, nomograph or data sheet published—$15 for each Rule of Thumb. Send your ideas to PIPE LINE INDUSTRY, P. O. Box 2608, Houston, Texas

Miscellaneous

—44—Find the Maximum Load That Can Be Lifted With Block and Tackle and Manila Rope

It is easy enough to find the advantage gained by blocks with several rope parts. Simply divide the weight of the load by the number of lines less one to find the pull on the rope. But this does not take into account friction, and this method can produce serious error.

A good rule of thumb for estimating the pull required is to allow a loss of 10 percent of the line pull at each sheave.

This can be expressed as a formula:

$$L = \frac{n \times W}{1.1^n}$$

Where L is the maximum load that can be lifted with the rigging; **n** is the number of lines less one and W is the maximum pull allowed for that particular size of rope. (This is equal to 900 d^2 for two inch and under)

Example: What is the maximum load which can be lifted with a three part line of ¾-inch Manila rope.

$$W = 900 \times \frac{3}{4} \times \frac{3}{4} = 506 \text{ lbs.}$$

$$n = 3$$

$$L = \frac{3 \times 506}{1.1 \times 1.1 \times 1.1} = \frac{1518}{1.331} = 1140 \text{ lbs.}$$

Reference: Rossnagle: *Handbook of Rigging*, McGraw-Hill, New York 1950.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas

Air Pressure Transfers Fuel From Service Truck

Here's a hook-up for a pipe line spread service truck that can save *time* in servicing equipment and *money* in original investment (in the service truck itself). Here's the way it works. There is a light compressor on the truck which supplies pneumatic power for the grease gun. Run pressure from the compressor to a regulator on top of the fuel tank and maintain about 15 psi in the fuel tank at all times. This pressure is sufficient to make the fuel flow freely from the tank into the tanks of the vehicles being serviced.

Modified Pickup Truck Designed to Fit the Job

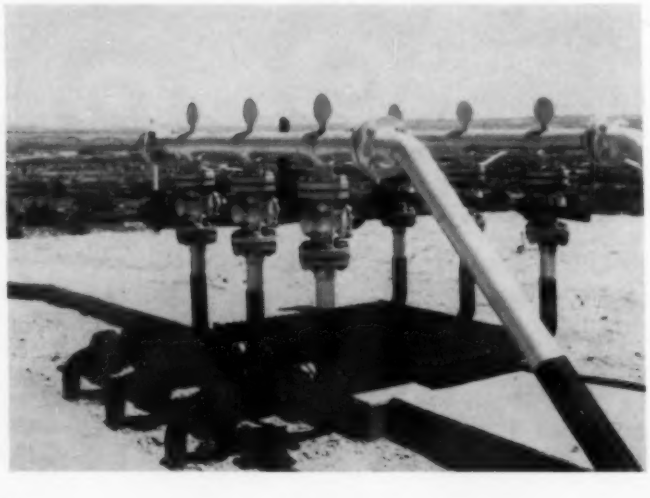
"Make the truck fit the job."

This was the idea that prompted Colorado Interstate Gas Co. to design the truck shown in the accompanying photo. It is tailored to fit the needs of corrosion and communications men. It is proving so successful that CIG has ordered four more trucks similarily modified.

The special body on the ½-ton pickup provides safe transportation for delicate electronic instruments and tubes. There are lashings and fastening devices in many of the compartments as well as foam rubber padding. Near the rear there is a reel mount for cable. At the right rear there is a vice for handling conduit.

There is a special top which will protect materials on the inside of the bed from the weather.

CIG's corrosion and communications maintenance men are happy with the truck—although they likely will make additional modifications in the future.



Streamlined Manifold Eases Gager's Worries

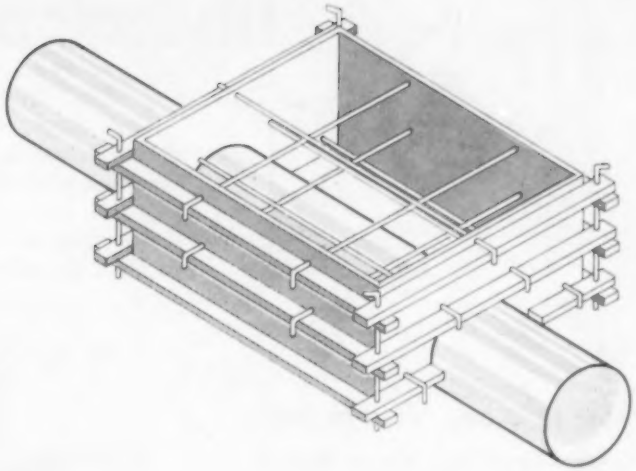
This manifold is streamlined as much as possible. Any improvements are going to be hard to come by. Note first that every valve is clearly marked with a steel plate tag. The piping beneath the grate in the sidewalk makes it easy to get at in case of painting or maintenance. The valves at either side are mounted at optimum operating height.

The risers parallel the walk and it would be hard to imagine a gager who could get the tanks mixed up with this set up.

Stinger Gives Boom Extra Height, Overhang for Drills

To simplify the handling of wagon drills on a ditching job through the rock country, one contractor added stingers like the one shown here to the sidebooms that handled the drills and pulled the compressors. The stingers, made of "H" beam gave the sideboom extra heights, necessary to effectively handle the drills and also it gave extra overhang that enables the operator to keep his tractor back from the ditch and do less booming up and down in keeping the drills straight.

Note the hook on the near side of the boom for the air compressor hose.



Simple Way to Construct Forms for Concrete Blocks

The time may come when it is necessary to pour a concrete anchor block without sufficient lumber and form buttons. Should this occasion arise, here's a neat way to accomplish the task:

First, cut the sides of the form from plywood. Stand them in place; measure whalers for holes at corners as shown. Then, nail the whalers in place and lock them with reinforcing rods at each corner.

Using a bending tool made from one-inch pipe as shown, deform the ends of the temperature steel to keep it from sagging and to help keep the forms true.

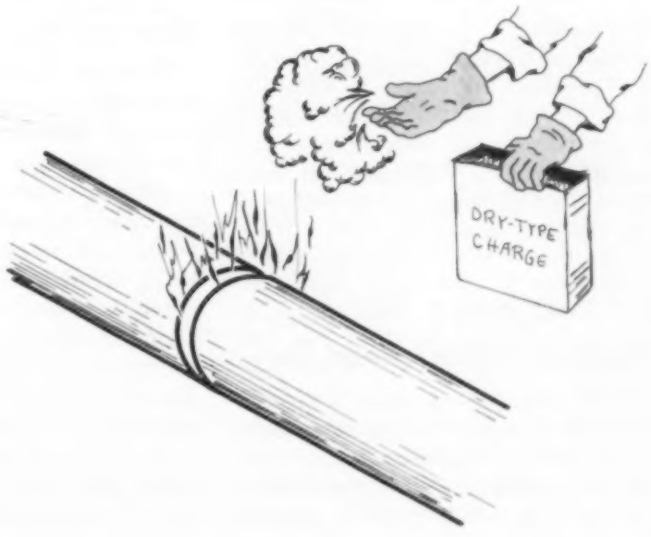
After the form has been poured and set overnight the corner pins can be pulled with a bar and the bends cut off with a cutting torch. Two men can strip a form off a poured weight and reassemble it complete with reinforcing rod in about 45 minutes. As the form and its reinforcing rod are one integral unit they can be assembled out of the ditch on dry land and set on the pipe with a side boom or any light lifting apparatus.

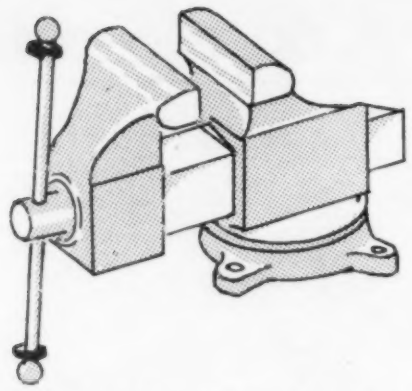
Pack a Sack of Fire Extinguisher Powder for Safety

There are times when it pays to take extra precautions. There is the long chance for example that a fire extinguisher may not work—perhaps it has not been serviced properly or the powder in it has packed too tightly to be operable. For this reason, it might be well to take an extra precaution when welding or burning must be carried out in a pump station or compressor building.

One way to enhance the safety at such times is to bring the cartons of dry-type fire extinguisher charges to the area and spot them at convenient locations.

Should an emergency arise, the powder can be thrown onto the blaze by hand. If the extinguisher is not needed, the cartons can be returned to storage.





How to Keep Vise Handle From Pinching Your Hand

This is simple—it's a wonder you haven't already done this. Simply wrap a ring of friction or rubber tape around either end of the handle. Then when it slips, it won't hurt your hand.

Safety Pin on Lube Barrel Prevents Serious Injury

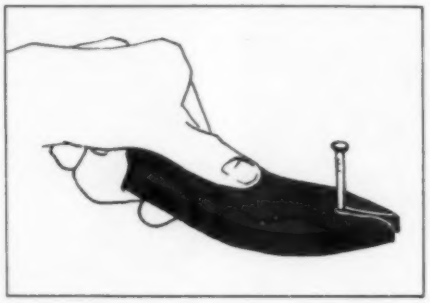
There is quite often the possibilities of serious injury resulting if a barrel should roll or fall from its structural support. Consequently, to eliminate

this possibility, an L-shaped pin was welded to the front leg of the holder. This enables the barrel to slide forward on the barrel holder until it comes into contact with the pin. This pin is made in a L-shaped form from ½-inch rolled stock and is welded in the position shown.

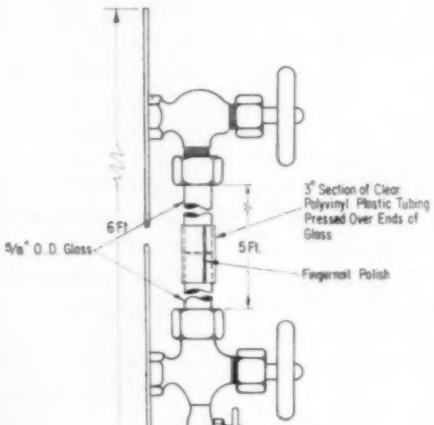
Hit Your Finger With Hammer Often? Read This

Ever notice a carpenter's thumb? Most of them have blood clots under the thumb nail, indicating that they too have trouble hitting the nail on the head every time. Little wonder that us pipeliners have trouble when we take hammer in hand, grasp the nail and swing away with the hammer—*#'*'!

This simple nail guide will solve the problem—and if your job calls for much nailing, and you'd rather be called a coward than have a sore thumb, cut an 8-inch strap from the tread of an old tire. Cut a slit in it



as shown in the drawing—sizing the opening for the nail you'll be using. Next, hold the device as shown, get out the old keg of nails and a hammer and take after the timber.

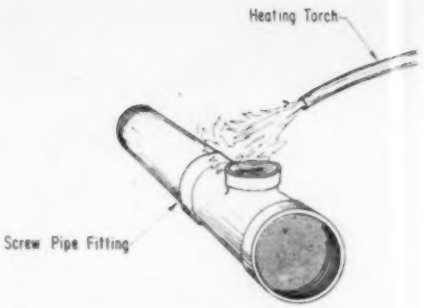


Protect Gage Glass From Thermal Expansion Failure

Very long gage glasses bring problems. The slip joint at the gage cocks may not suffice to take care of thermal expansion etc.

Here is a solution to this problem. Cut a 3-inch length of clear polyvinyl plastic tubing of the proper diameter to fit over the gage glass. Cut the latter in two pieces. Slip the ends into the tubing as shown, wetting with fingernail polish to prevent leaks. The flexible tubing will take care of expansion and contraction.

Of course, if the gage has to withstand great pressures, this simple remedy cannot be used.



Heating Torch Can Solve Problem of Unscrewing Pipe

What do you do when cheaters simply aren't long enough? When screw pipe fittings start crushing rather than back off?

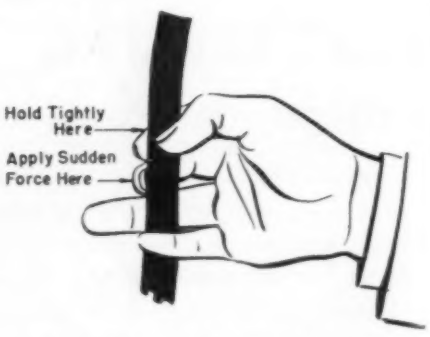
One solution, of course, is to take the offending pipe and fittings to a machine shop and say, "Unscrew it!"

But if you were to stick around the machine shop, you'd see the machinist simply heat the pipe with a heating torch. When it cools it will be loose in most instances.

So, the next time you feel the pipe crushing as you attempt to back off a fitting, simply haul out the heating torch!

Tear Electricians Tape Like an Electrician

Chances are the first time you ever heard and saw an electrician tear off a strip of tape with one hand, you thought he was concealing a knife. Actually, he can tear it more readily than the average man could cut it with a knife.



Here's the way he does it. He holds one edge of the tape between the index finger and thumb. The opposite edge faces in toward the circle made by the two digits. The little finger and fourth finger clamp the tape tight and the middle finger pushes sharply across the edge. The tape parts with a pleasing "snip," and surprising ease

So You Have to Make a Speech!

If you want to really put your talk across to your audience, use these sixteen suggestions

By Ernest W. Fair, Boulder, Colo.

JUST ABOUT every oil man at one time or another has to make a speech, or several of them, before a civic group, a business association meeting, a convention or what have you. And when that time comes he wants to make the best possible speech in the best possible manner.

Quite often, those who are faced with this prospect will find themselves in a real dilemma because they just don't know how to put a speech across to an audience. If you are ever in that situation, this list of suggestions will pull you through with flying colors.

It would be a good idea for you to clip this out so these pointers will be handy the next time you are preparing to deliver that prepared speech.

1. Say it your own way. If you want to avoid sounding like a stuffed shirt, speak in the same style and language you use in your everyday life; it'll come natural; any other way will be forced. If you pick up some data or information somewhere, present it in your own words, not those of the source.

2. Talk louder than you have to. Not only will you be sure to be heard clearly, but instinctively you will put more effort into what you say when you talk louder than normally.

3. Change the pitch of your voice. One pitch gets horribly monotonous. Whisper some, yell on another point and use your normal voice, but vary the pitch of your voice throughout the speech.

4. Keep your points down. You will make a much more lasting and worthwhile impression if you limit your message to three or four well emphasized points than if you attempt to "snow under" the audience with a deluge of facts and fancies.

5. Leave things alone. This means the necktie, the watch chain, the "specs" or anything else that attracts the attention of the audience from what you are saying and to what your hands are doing.

6. Look good. A good appearance means an awful lot toward getting the favorable attention of your listeners; so don't do as many business and professional men have a habit of doing—make the speech in the same clothes in which they went about their chores all day long.

7. Watch for repetition. Nothing ruins a good speech faster than constantly repeating a pet cliché or even a pet word. If it's good, it will register the first time it's heard; if not, then it is best not even mentioned that one time.

8. Stand still. Stand in the same position as much as possible and don't put on a military drill in front of your audience. They are not interested in such antics and besides it detracts from what you are saying.

9. Don't droop. It pays to stand on your toes when you talk. Don't sag or relax. It also pays to remain alert throughout the whole ordeal no matter how tired you may be, and give the audience the impression that you are full of energy and rarin' to go every minute you are talking.

10. Put on a good show. Your speech should be the high point of the evening's program; do your best to see that it is. The executive who begins his speech firmly convinced that he can give a lot better speech than the "guy" who preceded him or the one who spoke last week is going to give a better speech.

11. Work hard on the ending. It doesn't pay to have a top notch speech and an excellent delivery and then have the whole thing ruined by a bad ending. Say or do something the audience can enter into, can feel a part of, and can feel that they have really heard something which was worth the time they spent listening to you.

12. Never apologize. This goes for the weather, the speech, its length, the hour, your voice, or anything else. People don't want to listen to such things, and if you call attention to some small thing, the imagination of your audience will seize upon it and magnify it. If there is anything wrong, it is better to cover up the whole business and forget it, maybe no one will notice the situation anyway.

13. Time yourself carefully. The most common mistake of the first time speaker is to go to one of two extremes. He either makes his speech too short or too long. A good point can't effectively be put over in the average speaker's short speech (few of us can ever reach the heights of Lincoln's speech at Gettysburg). While on the other hand, dragging something out only buries it in dreariness. Timing is of the utmost importance in addressing any audience.

14. Be careful of jokes. A joke which has no point in your message doesn't belong there. If you must pull 'em, make sure they are well placed, well told and have some relation to your speech. Avoid dialect jokes—it takes an expert to put them over.

15. Surprise your audience. An unusual twist in the process of speech making always wins an audience's friendliness. For example, one speaker we knew stood on the platform leafing through some 100 typewritten pages of notes as he was being introduced. We all groaned inwardly at the prospect of a long and very dull speech ahead of us. Instead, the speaker looked straight into his audience and remarked that he was sure no one was interested in what he had worked up for a speech, threw the whole batch of typewritten paper into the wastebasket, and proceeded to give one of the best informal speeches we have ever heard.

16. Be sure of pronunciation. All of us have a habit of mispronouncing a few words and are usually never aware of what we are doing. However, when these are so spoken in even a speech before a small audience, they stand out like the well known "sore thumb" and can ruin the whole receptiveness of an audience.

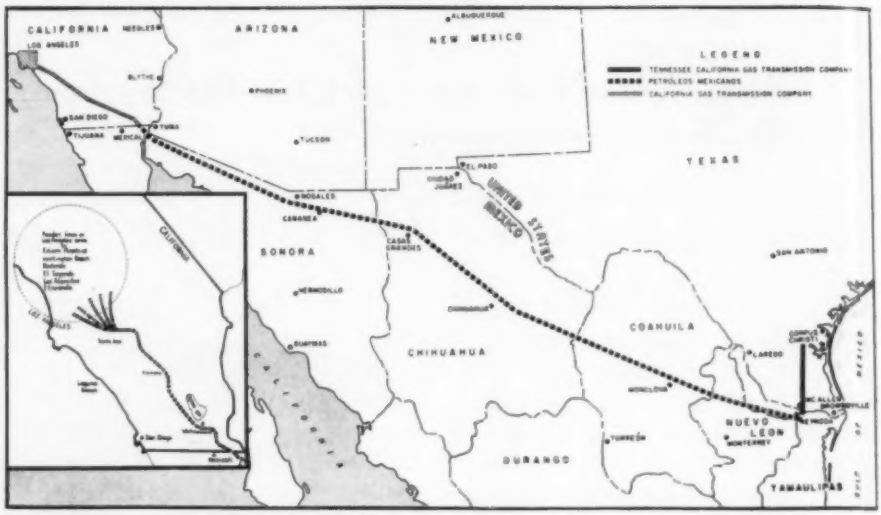
These 16 suggestions accomplished the task for one "amateur speaker"—they can be of as definite assistance to any other person who finds himself confronted with what used to be a terrifying assignment to speak before a large audience. —**The End**

Yellowstone Completes Montana Products Line

Yellowstone Pipe Line Company has completed construction of its 82-mile, 6-inch, products pipe line from Helena to Great Falls, Mont. It is a spur line off the Yellowstone main from Billings, Mont., to Helena and Spokane, Wash. The spur will connect with Continental Oil Company's terminal now nearing completion at Great Falls. Project included a station at Helena and a 3-inch jet fuel line from Great Falls to the Malmstrom Air Force Base. The line carries jet fuel, gasoline, heating and diesel oils.

WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, Construction Editor



Texas-Mexico-California Gas Line Route

The California Public Utilities Commission has opened hearings on the proposed pipe line project to import gas from Mexico into California. Southern California Edison Company is requesting permission to import gas from Mexico, and California Gas Transmission Company has applied for authorization to construct the line from Mexicali, Mexico, to Los Angeles. This is part of the 1,600-mile, $225 million project including a line from south Texas to Mexico, and a 1,200-mile line from Reynosa to Mexicali. Tennessee California Gas Transmission Company would lay the Texas Facilities and Petroleos Mexicanos would build the Mexican section.

Transcontinental Gas Plans $100 Million 500-Mile Construction Expansion Program

Transcontinental Gas Pipe Line Corporation is planning a $100-million construction expansion program which it hopes to complete in 1961. Transco is awaiting final approval of the Federal Power Commission on the major portion consisting of $70 million. An application for the additional facilities costing $30 million was filed with the FPC last month.

The program includes approximately 500 miles of new pipe line construction in Texas, Louisiana, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia, Pennsylvania and New Jersey. This will complete about half of the second looping of the company's main line.

The construction will include about 370 miles of 36-inch loops and about 70 miles of 30-inch loops in addition to smaller lateral and loop lines. Also, Transco plans to install two new compressor stations and additional horsepower in existing stations.

Completion of all facilities in pending and proposed applications will increase the system's daily allocated capacity from 1.2 billion cubic feet to nearly 1.5 billion. In addition, storage capacity would be increased from 340 MMcf to 457 MMcf per day giving the line a potential daily capacity of over 1.9 billion.

SunOlin Chemical Co. Plans Ethylene Line

SunOlin Chemical Company plans to lay an underwater ethylene pipe line across the Delaware River from Claymont, Del., to a point just north of Penns Grove, N. J.

The line will be tied in with the firm's ethylene-ethylene oxide plant being built at Claymont and will carry ethylene and other chemical liquids and gases. Crossing will be 6,000-feet wide and the line will be buried 25 feet. A rock fill will be used to keep lines from shifting and to assure protection from ships which may anchor in the area. Sun Pipe Line Company will provide consultation services for the $2 million project.

El Paso Gets Approval To Construct Station

El Paso Natural Gas Company has been granted authorization to build

and operate a 3,400-horsepower addition at its Eunice field compressor station in Lea County, New Mexico. The $1.2 million project will enable El Paso to take 28 MMcf of residue gas daily from Phillips Petroleum Company.

In another approval, Natural Gas Storage Company of Illinois was authorized to build facilities for removal of larger quantities of gas from Herscher storage field in Kankakee County, Illinois. The company will supercharge three 2,000-horsepower engines to 2,800 horsepower; construct a gathering system to tie in new wells, and drill seven new injection-withdrawal wells in the Mt. Simon and Galesville reservoirs.

These facilities will increase daily withdrawal by 75 MMcf to a total of 725 MMcf of gas daily.

Cities Service Gas Co Receives FPC Approval

The Federal Power Commission has authorized Cities Service Gas Company to construct facilities in 1960-62 at an estimated cost of $10 million.

Cities Service was granted permission to develop the Alden field in Rice County, Kansas, as an underground storage area; increase capacity of Kansas-Hugoton 26-inch line by adding 27,950 horsepower in new and existing stations and laying a 2.7-mile 26-inch loop, and construct a 1,800 horsepower addition to its Alva compressor station in Woods County, Oklahoma.

United Gas Plans 217-Mile, 30-Inch Line

United Gas Pipe Line Company plans to construct a 217-mile 30-inch gas pipe line across Louisiana from Lafayette to Monroe.

McQueen and Pilcher Named

The Federal Power Commission has appointed Milton A. Pilcher, former budget examiner with Bureau of Budget, Director of Administration for the FPC. Also the commission has appointed Malloy J. McQueen Deputy General Counsel.

Pilcher, who has been with the budget bureau since 1949, succeeds J. Kay Lindsay. McQueen, formerly associate general counsel of the Department of Health, Education and Welfare, succeeds John C. Mason, who was named General Counsel last year.

Trans-Southern Crosses Another River

Trans-Southern Pipeline Corp. has completed another river crossing, this one under the Tallapoosa River near Wadley, Ala. Dragline in background pulls pipe across river as sideboom tractor walks the pipe. Trans-Southern's 1,200-mile LPG system will extend from near Houston to Virginia.

French Companies Plan Major Crude Line to Connect Algerian Oil Fields

French pipe line construction in Algeria is continuing at a rapid pace. The latest big-inch crude line proposal will link the Edjele and Hassi Messaoud oil fields with a 400-mile, 30-inch pipe line. The line will also provide an outlet for Ohanet field between the two major fields.

The section from Hassi Messaoud to Ohanet is 330 miles. Contractors for the line include SOCOMAN, subsidiary of Cie de Pont a Mousson, which will lay 150 miles of the system by June, and GREP, Groupement des Societies Entrepose et Parisienne Pour L'Industrie Electrique en Vue de E'Tude et La Pose de Pipelines.

Plans also are being considered to extend the line about 120 miles to Amenas, southern terminal of the Edjele line.

Columbia Gulf Files Application With FPC

Columbia Gulf Transmission Company has filed an application with the Federal Power Commission seeking authorization for construction of about 97 miles of 30-inch main line loops and 29 miles of 12-inch lateral lines. The $15 million project would boost Columbia's capacity by 52 MMcf of gas daily increasing the daily volume to 718 MMcf.

The main line loops would be constructed in Kentucky, Tennessee, Mississippi and Louisiana. The lateral would be laid in Louisiana.

Transco Files With FPC For 15-Mile Loop Line

Transcontinental Gas Pipe Line Corporation has filed with the FPC for permission to lay 15 miles of 36-inch loop line, add weights to existing segments that will be flooded and relocate a water pumping station in North Carolina.

Transco plans to bypass the reservoir of the Cowan's Ford hydroelectric project of Duke Power Company on the Catawba River. Water impoundment will flood about 5½ miles of existing line to depths of 60 feet. Duke woud reimburse Transco about $1.3 million of the $2.8 million project.

Pasotex Lets Contract To H & K Construction

Pasotex Pipe Line Company has awarded a contract to H & K Construction Co. for 19 miles of 10-inch gas line near Falfurrias, Texas. The line will tie in with Transcontinental Gas Pipe Line Corporation's system.

Long Island Pipeline Company Plans $30 Million, 75-Mile Products Line

Plans have been revived for the products pipe line from Linden, N.J., to Long Island, N.Y. It would run from Linden, through Staten Island, under the Narrows, and deliver to LaGuardia and Idlewild airports and other Long Island areas. The $30-million line would be a 75-mile, 20-inch line with a 24-inch crossing of the Narrows. The river crossing already has been constructed.

The Carl M. Loeb, Rhodes & Company of New York is the promoter of the proposed line and Gulf Interstate Company has completed an engineering and economic study on the line. The Long Island Pipeline Company would be formed to operate the line.

The system would have a capacity of 300,000 barrels daily and would carry gasoline, jet fuel and heating oils.

Williams Brothers Co Building Austrian Line

Williams Brothers Company has been awarded a contract to construct 82 miles of 10-inch gas pipe line in Austria. The line will extend from Traismauer to Amstetten and will be owned and operated by NIOGAS.

Magna Pipeline Lets Gas Pipe Line Contract

Magna Pipeline Co., Ltd., has awarded contract for construction of its 15-mile, 7-inch underwater gas pipe line across the Strait of Georgia. The gas line will link Vancouver Island with the mainland. British Insulated Calender's Cables, Ltd., will lay the $7-million line.

Pipe for the project will be reinforced plastic lines which will carry 50 MMcf of gas daily. The line will reach a depth of over 800 feet.

Continental Oil Completes 65-Mile, 16-Inch Pipe Line

Continental Oil Company has completed a 65-mile, 16-inch gas line from Maurice-Milton area east of Mermentau, La., to the company's natural gasoline plant near Lake Charles, La. The company also laid an eight-mile line from the plant to the Lake Charles refinery.

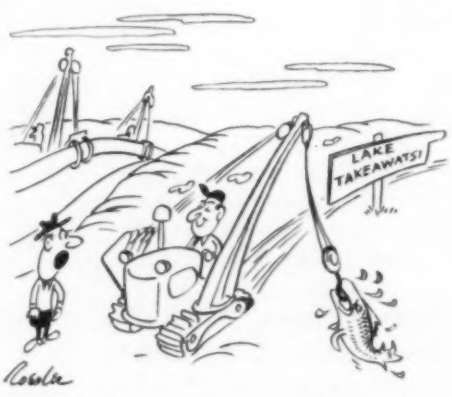
Constructed by Panama, Inc., the main line will have a capacity of 200 MMcf of gas daily. The line extending to the refinery will have a 300 MMcf capacity and will transport residue gas from the gasoline plant.

Northern Announces Plans For Construction Program

Northern Natural Gas Company will lay 1,200 miles of branch lines to make gas available to 165 additional communities during the year. Construction will begin early this year. Northern has filed two applications with the Federal Power Commission seeking project permission; one to sell 75 MMcf of gas to Michigan Wisconsin Pipe Line Company and another to make gas available to Reserve Mining Company's taconite processing plant at Silver Bay, Minn., and to communities of Silver Bay and Two Harbors, Minn.

Arthur Kline Re-elected Commission Vice Chairman

Arthur Kline has been re-elected by the Federal Power Commission members to serve as vice chairman for another year. Kline, a Republican, took office as a member of the FPC in June 1956. He previously served as assistant attorney general of Wyoming, City Attorney of Cheyenne, Commissioner on Uniform State Laws in Wyoming, and Judge of First Judicial District of that state.



"Been goofing off again, eh Sam!"

United Producing Company Constructs Gas Pipe Line

United Producing Company, Inc., constructed 18 miles of gas pipe lines and gathering system to deliver gas from Paint Creek field in West Virginia to Amere Gas Utilities Company. Amere also laid 16 miles of line. United Producing is a subsidiary of United Carbon Company of Houston and Amere is a subsidiary of United Fuel Gas Co.

NGPL Plans $52 Million Construction Expansion

Natural Gas Pipeline Company of America is planning construction of 257 miles of 30-inch loops and 89 miles of loops for its 1961 construction program. Total cost for the projects would be over $52 million and the new facilities would increase the company's system 160 MMcf of gas daily.

Trans-Southern Pipeline Lets Engineering Contract

Williams Brothers Company has been appointed to do design-engineering work for Trans-Southern Pipeline Corp.'s LPG pipe line which will extend from near Houston to South Carolina.

American Louisiana Gas Lets Contract on 24 Miles

American Louisiana Pipe Line Company has awarded a contract to Ford, Bacon & Davis for 24 miles of 24-inch gas pipe line. The line will run from Krotz Springs to Latell, La.

Pan American Lets Contract To Golightly Construction

Pan American Gas Company has let contract to Golightly Construction Company for its system between Pasadena and Texas City, Texas. The line consists of 32 miles of 12-inch gas pipe line.

H.B. Zachry Co. Laying 55 Miles, 20-Inch for NGPL

A contract has been awarded to H. B. Zachry Co. for construction of 55 miles of 20-inch gas lines for Natural Gas Pipeline Company of America. The line will run between Falfurrias to Hebbronville, Texas.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U.S.

Algonquin Gas Transmission Co., Boston, 25 miles, 20-inch; 8 miles, 8-inch, gas, and 12,000 hp addition in Massachusetts, $6 million, approval FPC.

Arkansas Louisiana Gas Company, Shreveport, La., 58 miles, 2-6-inch, gas, planned.

Belle Fourche Pipeline Co., Casper, Wyo., 103 miles, 8-inch, crude, Fiddler Creek field to Lance Creek, Wyo., and branch lines from North Donkey Creek field to Rozet and Miller Creek fields, $2¾ million, approved by Wyoming Public Service Commission.

Border Gas Transmission Company, 300 to 400 miles, gas, gathering, in South Texas, $10 million, planned.

California Gas Transmission Company, Los Angeles, (subsidiary of Tennessee Gas Transmission Company), 292 miles, 20-34-inch gas, from Mexico-California border near Mexicali, to Los Angeles and 10,000 hp. to tie into Texas Mexico-California line, $50 million, before FPC and California Public Utilities Commission.

Carolina Pipeline Company, Columbia, S. C., 85 miles, 8-inch, gas, in South Carolina, $5 million, before FPC.

Coastal States Gas Producing Co., Corpus Christi, Texas, 60 miles, 10-inch, gas, gathering, La Salle and Frio counties, Texas, before FPC.

60 miles, small diameter, gas gathering line, to tie in with system under construction and extend to Pearsall County, Texas, planned.

25 miles, gas, Associated Gas & Oil Co. field to South-Tex Corp., processing plant west of Corpus Christi, Texas, planned.

Coastal Transmission Corp., Houston, 81 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas, and Eunice, La., and additional 1,500 hp at Robstown, Texas, $6.2 million, FPC authorization.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, 34-inch, gas, Green River, Wyo.,-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado, 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, FPC conditional authorization.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Company, Houston, 97 miles, 30-inch, loops in Kentucky, Tennessee, Mississippi and Louisiana; 29 miles, 12-inch lateral in Louisiana, $15 million, before FPC.

El Paso Gas Supply Company, El Paso, Texas, 228 miles, 30-inch, gas, main, Live Oak to Sutton County, Texas, $30 million, before FPC.

El Paso Natural Gas Company, El Paso, 199 miles, 30-inch, Permian-San Juan crossover loop, before FPC.

17 miles, from Pacific Gas Transmission Co. facilities to near Spokane, Wash., before FPC.

34 miles, 20-inch, Puckett to Goldsmith, before FPC.

23 miles, 20-inch, Goldsmith to Eunice-Plains line, before FPC.

9 miles, 20-inch, Goldsmith-Plains loop, before FPC.

43,600 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, before FPC.

400 miles, 34-inch, Salt Lake City, Utah, to California border, FPC conditional authorization.

El Paso Natural Gas Products Company and **El Paso Products Pipeline Co.,** 32 miles, 6-inch, crude, from Patrick Draw Oil and Gas Field to Wamsutter, Sweetwater County, Wyoming, before Public Service Commission.

Equitable Gas Company, Pittsburgh, Pa., 31 miles, 16-inch, and 26 miles, 20-inch, in West Virginia and Pennsylvania, $5 million, before FPC.

Great Northern Railway, St. Paul., 110 miles, crude, fields in Burke and Bottineau counties to Minot, N. D., $3½ million, contract let on 50 miles to **Curran and Company.**

Hope Natural Gas Company, Clarksburg, W. Va., 20 miles, 20-inch, gas, in Lewis, Ritchie and Pleasants counties, W. Va., $2 million, FPC authorization.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 199 miles, 2 to 6-inch, gas, laterals; 20,000 hp in five new stations; $12 million, before FPC.

Kansas-Nebraska Natural Gas Company, Hastings, Neb., 165 miles, 2-8-inch, gas, extension from Alliance, Neb., to Chadron, Crawford, Hemingford, Hay Springs, Gordon and Rushville, Neb., before FPC.

45 miles, 2-3-inch, gas, in Kansas, approved by Kansas Corporation Commission.

2,000 hp addition at Scott City, Kan., FPC approval authorization.

2,500 hp addition at Holcomb, Kan., before FPC.

Lone Star Gas Company, Dallas, 52 miles, 18-inch, Springtown to Gordon, Texas, planned.

47 miles, gathering lines in Palo Pinto, Erath and Stephens counties, Texas, planned.

Long Island Pipeline Company, New York, 75 miles, 20-inch, products, Linden, N. J., to Long Island, N. Y., $30 million, planned.

Lo-Vaca Gathering Co., 230 miles, 6-20-inch, gas, gathering, Live Oak to Lavaca County, Texas, planned.

Matador Pipe Line Corp., Denver. 175 miles, crude, from Bottineau, Burke and Renville counties, N. D., to Cromer, Man., Canada, $4 million, proposed.

Michigan Wisconsin Pipe Line Co., Detroit.

37 miles, 6 and 12-inch lateral loops in Wisconsin, before FPC.

29 miles, 30-inch, loops, Illinois, Indiana, and Michigan, 3,000 hp. station, Janesville, Wis., before FPC.

Two 2,000 hp units at Meade, Kansas; one 2,000 hp unit at Havensville, Kansas, before FPC.

Mid-America Pipe Line Co., 405 miles, 10-inch, LPG, Superior, Wis., to Chicago, $12 million, considered.

Natural Gas Pipeline Company, Chicago, 62 miles, gas, pipe line and various river crossings, FPC authorization.

257 miles, 30-inch, gas, loops, $28 million, planned.

89 miles, gas, loops, planned.

New Haven Pipeline, Inc., products line, New Haven, Conn. to Springfield, Mass., $2.5 million, planned.

Niagara Mohawk Power Corp., 122 miles, 12-inch, Watertown and Massena, N. Y., contract let to Fulghum Contracting Corporation pending FPC approval.

Northern Natural Gas Company, Omaha, Neb., 236 miles, gas, in Kansas, Nebraska, Iowa, Illinois and Wisconsin and 14,050 hp, $25 million, before FPC.

124 miles, in Oklahoma, Kansas, Nebraska, Iowa, and Minnesota and 17,360 hp, $17 million, before FPC.

22 miles, in Iowa, $673,100, before FPC.

Northwestern Refining Co., crude gathering system, Rival and Lignite fields, North Dakota, $625,000, Public Service Commission approval.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Panhandle Eastern Pipe Line Co., Kansas City, 305 miles, 30-inch, 40 miles, 26-inch, gas, loops, and 43,000 hp, and gathering facilities, $60 million, before FPC.

200 miles, 22-24-inch, gas, lateral, from Elk City, Okla., to Haven, Kan., before FPC.

Pan American Gas Company, Tulsa, 50 miles, 12-inch, gas, La Porte to Pasadena to Texas City, Texas, contract let on 32 miles to **Golightly Construction Co.**

Peoples Gas Light & Coke, Chicago, 29 miles, 36-inch, gas between North Shore and Calumet stations, planned.

Peoples Gulf Coast Pipeline Company, Chicago, 27 miles, gas and turbocharger additions to 71 compressor engines, befor FPC.

Southern California and Southern Counties Gas Cos., Los Angeles, 93 miles, 34-inch, California-Nevada border to Newberry, Calif.

St. Lawrence Gas Company, Inc., Ogdensburg, N. Y., 75 miles, gas, main, United States-Canadian border to Ogdensburg, N. Y., $3.4 million, FPC examiner approval.

SunOlin Chemical Company, Philadelphia, 6,000 feet, ethylene line, under Delaware River, Claymont, Penn., to Penns Grove, N. J., $2 million, planned.

Tennessee California Gas Transmission Company, (subsidiary of Tennessee Gas Transmission Co.), 100 miles, 26-inch, gas, gas fields in South Texas to Texas-Mexico border near Reynosa, before FPC.

Tennessee Gas Pipeline Co., Houston 191 miles, 30 and 36-inch loops, in Ohio, Pennsylvania and New York, 72 miles of gathering lines and 43,600 hp in five stations, $46 million before FPC.

158 miles, 36-inch, gas, loops in Mississippi and Louisiana, FPC authorization.

21 miles, 16-inch, 2 miles, 12-inch, gas, Louisiana coast, Vermilion blocks 46 and 64, $3 million, before FPC.

50 miles, 10-16-inch, gas, offshore Louisiana, FPC authorization.

Texas Eastern Transmission Corp., Shreveport, La.

66 miles, 30-inch, gas, loops, between Vidor, Texas, and Lambertville, N. J., and 33,710 hp in four existing stations, $17.5 million, temporary FPC authorization.

Texas Gas Transmission Corp., Owensboro, Ky., 96 miles, 26-30-inch, gas loops, Louisiana, Arkansas, Mississippi, Tennessee, Kentucky and Indiana; 50 miles, 8 and 16-inch extension into Terrebonne, La. producing area, $16.8 million, before FPC.

Transcontinental Gas Pipe Line Corporation, Houston.

211 miles, 36-inch, and 69 miles, 30-inch, loops and additional 32,040 hp, in Texas, Louisiana, Mississippi, Alabama, Georgia and South Carolina, $52 million, FPC examiner approval.

163 miles, 36-inch, gas, loops, in Louisiana, Alabama, Mississippi, Georgia, North and South Carolina, Virginia, Maryland and Pennsylvania, 10,500 hp, $30 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, FPC authorization.

Trans-Southern Pipeline Corp., Houston, 1,080 miles, 12-inch, LPG, from Mont Belvieu, Texas, to Danville, Va., and 215-mile spur line from Atlanta to Georgia-Florida border, $63 million, planned.

Trunkline Gas Company, Houston, 252 miles, 30-inch loops, and 140 miles, laterals, between Longville, La., and Tuscola, Ill., $45 million. Contracts let on 155 miles to Cape Construction, Western Pipe Line, Panama-Williams, Panama Inc., and Grayco.

United Gas Pipe Line Co., Shreveport, La., 59 miles, 36-inch, gas, lateral between Bastian Bay field and Plaquemines Parish, La., before FPC.

217 miles, 30-inch, gas, Lafayette to Monroe, La., planned.

Union Texas Natural Gas Corp., (joint project with Phillips Petroeum Co., Warren Petroleum Corp. and Tuloma Gas Products Co.) 1,000 miles, LPG, Houston to North Carolina, $35 million, planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells counties, Texas, $15 million, before FPC.

West Shore Pipe Line Co., 250 miles, 10-16-inch, products, East Chicago, Ind., to Green Bay, Wis., planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. Government.

Ajax Alberta Pipeline Ltd., 28 miles, 10-inch, gas, main, Morinville to Westlock, Alta., planned.

Assistencia de Oleodutos du Petrobras, Rio de Janeiro, 280 miles, 12-inch, crude, Rio de Janeiro to Belo Horizonte, Brazil, planned.

Abu Dhabi Marine Areas Ltd., (British Petroleum Co. and Compagnie Francaise Des Petroles) 20 miles, 18-inch, crude, from Umm Shaif offshore oilfield to Das Island, Persian Gulf, planned.

Barnabos Group (Italian Interests), crude line from Venice, Italy, to Insbruck, Austria, with extension to Munich, Germany, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

British American Oil Co., Ltd., Toronto, 125 miles, gas, Pincher Creek fields to Calgary, Alta., before Alberta Public Utilities Board.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India. Contract let on 250 miles to **Mannesmann-Saipem.**

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Foothills Pipe Lines Ltd., 1,300 miles, LPG, from Alberta-Saskatchewan border to Chicago, tie-in with Westalta Products Pipeline proposed system in Alberta, $100 million, before Alberta Board of Public Utilities Commissioners.

Gas del Estado, Buenos Aires, 1,050 miles, 30-inch, gas, Comodoro Rivadavia field to Buenos Aires, $380 million, bids submitted for design and construction by Texas Eastern Transmission Corp., ENI, and an Argentine firm.

Gas Trunk Line of British Columbia, Vancouver, 250 miles, 30-inch, gas, main, Fort Nelson to Taylor, B. C., planned.

Gases Naturales de Colombia, S.A., 140-mile, 10-inch, gas, Cicuco field to Barranquilla, Colombia, planned.

Hughenden Pipeline, 125 miles, products, Dick Lake gasoline plant to Hughenden Region, Alta., planned.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered, products pipe line, Superior, Wis., to Chicago, considered.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

Naphtha Israel Oil Co., 75 miles, 6-inch, gas, Rosh-Zohar field to Ashdod Yam on Mediterranean planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

NIOGAS, 82 miles, 10-inch, gas, Traismauer to Amstetten, Austria, contract let to **Williams Brothers Company.**

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta., 110 miles, 10-inch, gas, main, Lac La Biche to Edmonton, $3 million, planned.

Northern Pipe Line Company, 153 miles, 16-inch, crude, from Regina, Saskatchewan, to Clearbrook, Minn., $10 million, planned.

Oasis Oil Co., of Libya, (Amerada, Continental and Ohio Oil Company), 86 miles, 30-inch, Dahra field to Es Sider, Libya; 36 miles, 20-inch, Mabruk to point between Es Sider-Dahra, before Libyan Petroleum Commission.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Pembina Pipe Line, Ltd., Edmonton, 1,200 miles, LPG, from Alberta gas fields to eastern Canada, planned.

Petroleos Mexicanos, 4, 6 and 8-inch, products, Mexico City-Puebla to Cuernavaca, planned.

1,240 miles, 34-inch, gas, Reynosa to Mexicali, Mexico $160 million, negotiating with Tennessee Gas Pipeline Company for design and construction of the line.

360 mile, 12-inch, products, Minatitlan to Puebla and Mexico City, planned.

Products, Guadalajara to Tepic, planned.

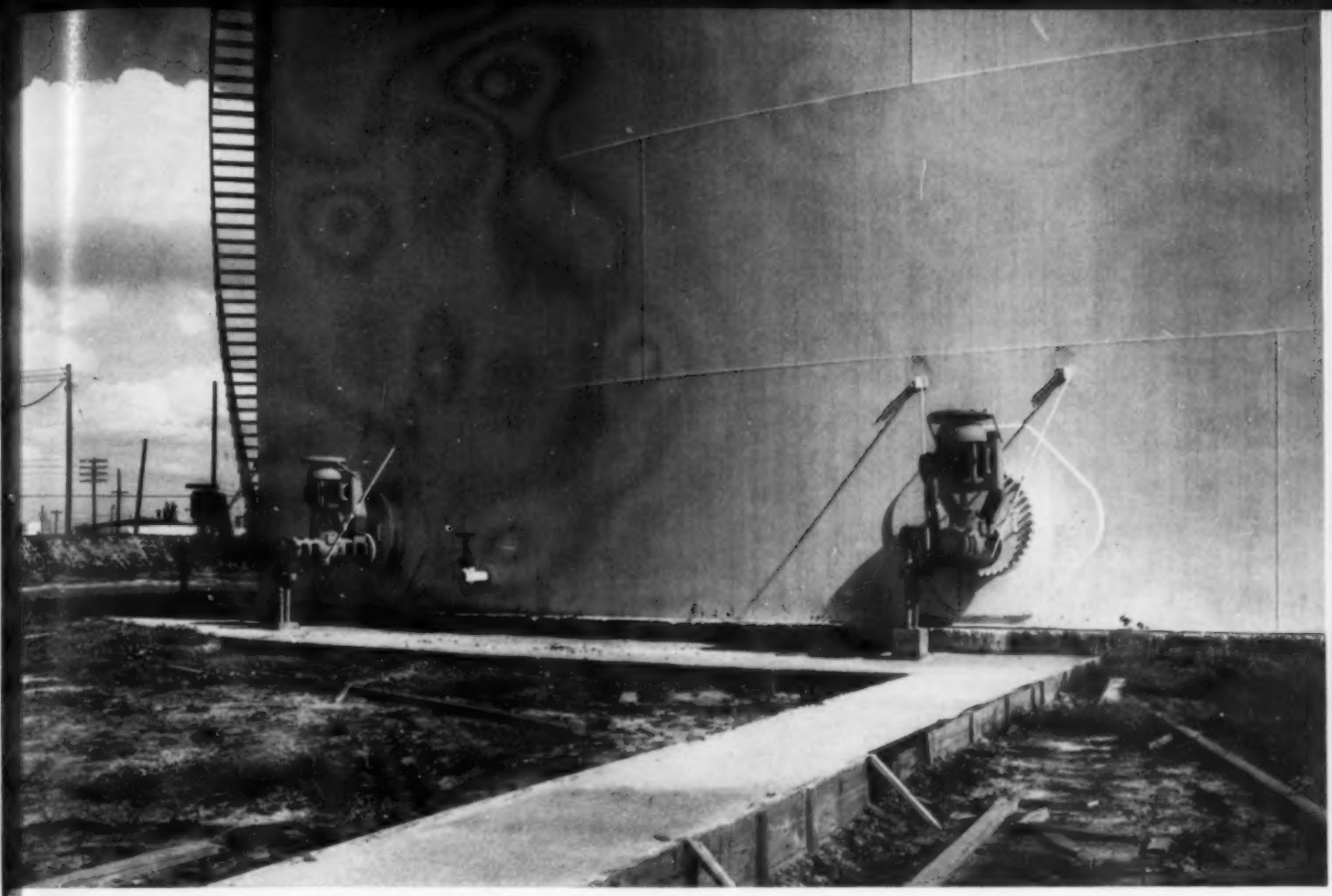
Products, Aguascalientes to Zacatecas, planned.

6-inch, products, Guaymas to Ciudad Obregon, considered.

8-inch products, Guaymas to Hermosillo, considered.

8-inch, gas, Tierra Blanca to Veracruz.

14-inch, gas, Mexico City to Salamanca, underway.



How they keep crude from **stacking up like pancakes**

Surging into this tank come crudes from wells scattered over 23 counties.

Out of the tank comes *one* crude, at the right gravity to feed to refineries more than 450 miles away.

For the men who run the tank farm, it's no chore at all to blend 122,000 barrels of crudes ranging from less than 20° to above 85° in gravity. They do it by flipping three switches.

The LIGHTNIN Mixers you see here do the rest. While the tank is filling, and for two or three hours before it goes on suction, the mixers create a powerful, steady turnover that breaks up stratification from the bottom up. The outgoing tender of crude stays within a degree or two of constant gravity.

Control BS&W, too. That's not all. These mixers help keep sludge from settling on the tank bottom and stealing valuable storage space. They keep the tank working at its full capacity.

Multiply these savings by the number of tanks at this farm equipped with LIGHTNIN Mixers—and you can see why more than 50 pipeline companies and 35 leading oil companies use this easy way to keep operating costs in line.

How about you? If you'd like to see how LIGHTNIN Mixers on your big tanks can save you as much as $1000 per tank per year, call in your LIGHTNIN representative. He's listed in Composite Catalog. Or write us today.

YOU CAN ADD as much as 12% extra storage capacity to your tank farm—by using LIGHTNIN Mixers to keep tanks free of space-eating sludge. Mixing results are unconditionally guaranteed.

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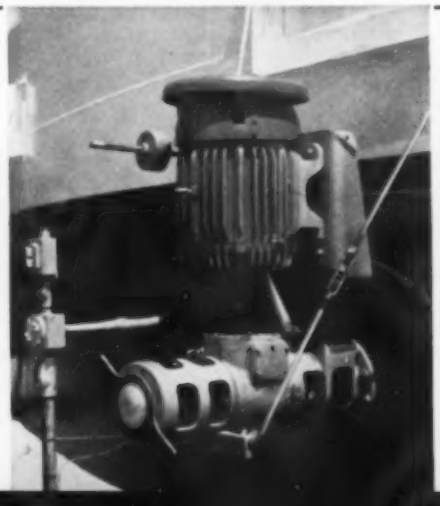
Get these helpful bulletins on BS&W control and LIGHTNIN Mixers. Check, tear out and mail to us today with your name and company address. Free—no obligation.

- ☐ BS&W Control with LIGHTNIN Mixers (B-503)
- ☐ Side-entering mixers, 1 to 25 hp (B-104)
- ☐ Data sheet for figuring mixer requirements (B-107)
- ☐ Condensed catalog describing LIGHTNIN Mixers—all types (B-109)
- ☐ LIGHTNIN rotary mechanical seals to eliminate stuffing-box maintenance (B-111)



MIXING EQUIPMENT Co., Inc., 196-b Mt. Read Blvd., Rochester 3, N.Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.

In Europe: Lightnin Mixers, Ltd., Poynton, Cheshire, England

Gas, Ciudad Carmen to Ciudad Pemex.

8-inch, crude Comalcalco to Minatitlan.

Crude, Minatitlan to Salina Cruz, contingent on proposed refinery on Pacific Coast.

149 miles, 10-inch, products, Ciudad Pemex to Minatitlan, planned.

181 miles, 4-inch, products, Mexico City to Salamanca, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, approved.

Provincial Pipe Lines, Ltd., 700 miles, 3-16-inch, hydrocarbon line gathering system in Alberta, $25 million, before Alberta Oil and Gas Conservation Board.

Qatar Petroleum Company, Qatar, 60 miles, 6-10-inch, gas, Dukhan to Doha, Qatar, engineering contract let to Pencol Pipeline & Engineering Consultants.

Quebec Gas Transmission Lines, Inc., Montreal, 300 miles, gas, main, Quebec to Montreal, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Saskatchewan Power Corp., 179 miles, 4-6-8-inch, gas, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa, to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extensions to Karlsruhe and Munich, Germany, planned.

Societe du Pipe Line Sud-European, Paris, 432 miles, 34-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, approved by French cabinet.

Soc. Siciliana Metanadotti, gas line from Hassi R'Mel field in Algeria through Tunisia, across Mediterranean to Sicily and into Italy, considered.

SN Repal, Paris, France, 180 miles, 8-inch, gas condensate, Massi R'Mel to terminal on Hassi Messaoud to Bougie line in Algeria, planned for 1961.

SOPEG, and **CREPs,** 400 miles, 30-inch, crude, connect Hassi Messaoud and Edjele fields in Algeria, contracts let to **SOCOMAN and GREP, Groupement des Societies Entrepose et Parisienne Pour L'Industrie Electrique en Vue de L'Tude et La Pose de Pipelines.**

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Syrian Pipeline, Damascus, 500 miles, crude, from Karshuk field, Syria, to Mediterranean, planned.

300 miles, products, from Homs to tank farms in Damascus, Aleppo and Latakia, planned.

Trans-Canada Pipe Lines Limited, Toronto.

268 miles, 34-inch, loops, and additional hp planned for 1961, $69 million.

122 miles, 34-inch, loops, hp additions, $46 million, planned for 1962.

Trans-Prairie Pipelines, Ltd., Edmonton, crude line, from Weyburn field to Regina-Moose Jaw areas, $5 million, considered.

Trunk Pipelines Ltd., London, 70 miles, products, Canvey Island to Denham, Buckinghamshire, bill before Parliament. Extension of line from Denham to Birmingham, planned.

Westalta Products Pipeline Ltd., 900 miles, LPG, from Northern Alberta to Saskatchewan border, to deliver hydrocarbons to Foothills Pipe Lines, $40 million, before Alberta Board of Public Utilities Commissioners.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia, to Villa Hayes, Paraguay, considered.

Westcoast Transmission Company, 688 miles, 30-inch, gas, loops, Peace River area of British Columbia, to United States border, planned.

AGA Forms Gas, Inc., for World's Fair Exhibit

The American Gas Association became the first exhibitor to contract for space in the 1964-65 New York World's Fair. John E. Heyke, president of The Brooklyn Union Gas Co., second from right, presents $100,000 check to J. Anthony Panuch, vice president of New York World's Fair, for half of first year's rental of exhibit site. Also present at contract signing were Thomas J. Shanley, left, liaison officer between the organizations, and Stanley B. Finch, executive secretary of Gas, Inc.

FPC Commissioners Named

Two new commissioners, including a chairman, were appointed last month to the Federal Power Commission by President Kennedy. Joseph Charles Swidler, a Nashville, Tenn., lawyer, was named chairman of the agency and Howard Morgan, former Oregon public utility commissioner, was added as a commissioner.

Swidler fills a commission opening created by Thomas Donegan, who turned down a recess appointment after the Senate failed to confirm his nomination by President Eisenhower. Morgan succeeds Paul A. Sweeney, who had received a recess appointment from President Eisenhower which will be withdrawn.

Both appointees are Democrats. Swidler's term runs until June 1965 and Morgan's expires in 1963.

PLCA Officers Elected

Maurice S. Williams, president of Panama Williams Corporation, was elected president of the Pipe Line Contractors Association at its annual convention in San Francisco, January 15-18. Williams succeeds Jack S. Gray, president of Grayco Constructors, who served as president for 1960.

Other officers named were James W. Sharman, Sharman, Allen, Gay & Taylor, Inc., first vice president; Roger L. Pentzien, Pentzien, Inc., second vice president, and Arthur E. Poole, Hallen Construction Company, treasurer.

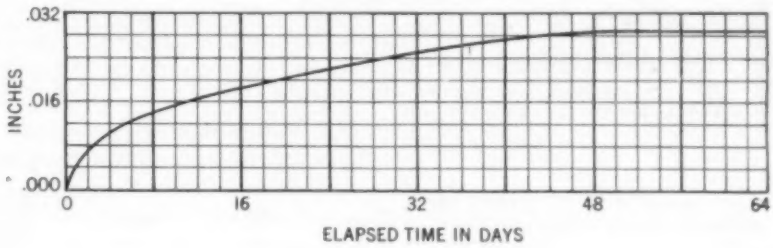
Officers elected include Richard D.

NEWS FROM DOWN THE LINE!

Are all pipeline insulators as alike as two peas in a pod?

They're not alike, not in physical properties! When plastic insulators first became available for pipeline use, WmSON felt they were inferior to the steel and block types then available. We delayed our entry into the field until we could provide a plastic material to withstand field abuse and wear. We found that material in a high density polyethylene which could be injection molded to provide low cost insulators of the highest quality.

Our decision has proved sound. Breakage and excessive wear of glass fibre reinforced plastics, particularly in large sizes, has created a lack of confidence in plastics in general, but the M-2 Plastic THINsulator® has proved its stamina. Its high resistance to cold flow has been proved. Deflection test results: 1000 p.s.i. on each THINsulator runner for 64 days — total cumulative deflection only 0.029". Max. temp. during test, 105° F., min. temp., 75° F.



Its low coefficient of friction causes it to slide easily inside casing. The M-2 is completely resistant to impact fracture (4.0 ft. lbs./in. notched) and has successfully worked on 36" pipe, ½" wall, pulled in excess of 500 feet. We are convinced that it will perform as well or better than any other insulator on the market, including all known steel types. Other physical properties: *Dielectric strength* — (short time, ⅛" thickness) 500 volts per .001 inches (D149-55T); *Tensile strength* — 4400 p.s.i. at 20 in./min.; *Elongation* — 25% 20 in./min.; *Abrasion resistance* — Taber index 5.7.

The increased acceptance of the M-2 THINsulator has brought production to a level of real economy in injection molding. These cost savings are being reflected in new WmSON prices for 1961.

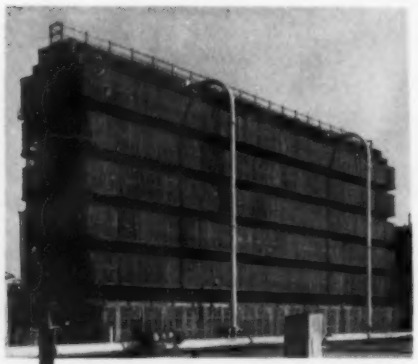
In planning '61 cased crossings, don't pay a premium for other insulators — use WmSON engineered M-2's and save!

T.D. Williamson, Inc.

P. O. BOX 60 • TULSA 2, OKLAHOMA

REPRESENTATIVES AROUND THE WORLD

NEW LIFE FOR OLD COOLING TOWERS



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If your installation has been damaged by fire, storm, age, or chemical deterioration, or if your old tower has lost efficiency and is in need of modernization, a Fluor Repair Crew will have it in top working order with a minimum amount of down time. All work is accomplished in complete accordance with local building codes and modern cooling tower practices.

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CTI

Cagny, Contracting & Material Company, and C. Wayne Fowler, Fowler-Tatom, Pipeline Contractor. Richard A. Gump remains executive secretary and Hailey A. Roberts is assistant executive secretary.

AGA Fuels Policy

The American Gas Association has assured President Kennedy that the gas industry will offer fullest cooperation in any impartial study of the nation's energy resources.

Lester T. Potter, president of AGA, has written to the President stating, "we dedicate our industry's full resources in support of any objective study of the fuels." He refers, of course, to the National Fuels Policy—a proposed Congressional study on the necessity and desirability of establishing a new over-all fuels policy.

In the letter, Potter expressed his industry's concern over the study's current sponsorship by the coal interest and their allies.

"There is considerable evidence to show that this group, under the guise of conservation, is aiming to undermine the consumers' traditional freedom of choice of fuel, and to ultimately assure a competitive advantage for coal by enlisting the compulsive power of government," Potter said.

Northern-Monterey Agreement

Northern Natural Gas Company has agreed to purchase from Monterey approximately 16 percent of the common stock of Transwestern Pipeline Company. Transwestern recently built a $200-million line from West Texas to California.

Northern agreed to buy 950,000 shares of Transwestern stock from Monterey for $11,875,000 or $12.50 per share.

Bank Your Ideas

If your company starts a Coin-Your-Ideas program or something similar to it, don't pass it up—it could mean a fortune—to you.

Prime examples of fortunate coin-your-idea members are Carlos C. Rabb, Jr., and Donald E. Cox, of Interstate Oil Pipe Line Company. These clever employes received a joint award of $4,000 for just making a suggestion.

What was the big idea?

The employes suggested modification of metering facilities for pipe line delivery of LPG products to two plants in the Baton Rouge, La., area. The result has increased operating efficiency and substantial annual savings—for the company and Rabb and Cox.

Rabb was foreman of Interstate's LPG pipe line system in the Baton Rouge area and Cox was assigned temporarily to give engineering assistance in putting the system into operation. Their suggestion called for resourcefulness beyond the call of their normal duties, the chief criterion by which eligibility for awards is determined at Interstate.

Rabb is district foreman for Ferriday district Louisiana, and Cox is assigned to the construction of a products line in Illinois and Wisconsin in which the company has an interest.

Interstate has had a suggestion system since 1918, and in 1950 revitalized it. Now the company receives an average of 25 suggestions per 100 employes annually.

Monetary awards are granted for suggestions which result in reduced costs, increased efficiency or improved safety conditions.

Anyway you look at it, it's a good club—ask Rabb and Cox.

The Name that MEANS Highest Quality Performance

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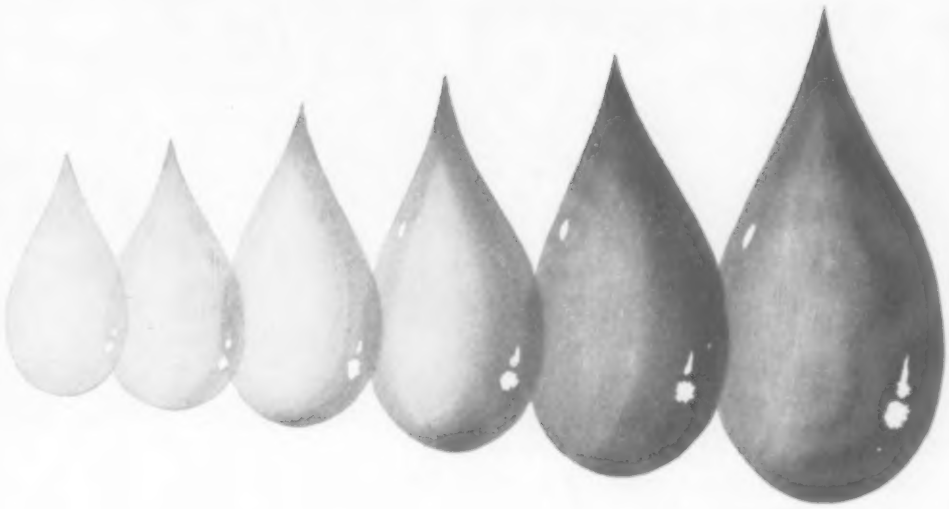
When Viscosities Change



Do you change the meter?

ROCKWELL TURBO-METERS* measure liquids from heavy crudes to LPG without recalibration

You never need to recalibrate the Rockwell Turbo-Meter for changes in product or temperature since a built-in compensator automatically makes the corrections under continuous service conditions.

The only work involved is to read this meter. With optional remote registration you can even do this in your office.

A turbine rotor mounted on ball bearings turns freely in the flowing stream without close clearances or metal-to-metal contact to cause wear. With this construction, head loss is negligible and the meter retains its calibration without attention.

Rockwell Turbo-Meters are the same size as pipe diameters. They are much smaller, lighter and the cost is less than half that of comparable size displacement meters. Write for bulletin PI-417. Rockwell Manufacturing Company, Dept. 125B Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

* Now available in two sizes: Model 7M - 7000 BPH cap., Model 15M - 15000 BPH cap.

TURBO-METERS
another fine product by
ROCKWELL

What's Happening among MEN in the INDUSTRY

Frank A. Moore has been named acting assistant manager of the **Marathon Pipe Line Company's** Rocky Mountain region. Moore, who is staff assistant to the president, will headquarter in Casper, Wyo.

He replaces **M. E. Parker**, who is on loan to the **Oasis Oil Company of Libya, Inc. William B. Read**, supervisor of Engineering Department, will succeed Moore as staff assistant to president **R. L. Linville**, supervisor of Regional Pipe Line Engineering Department, transfers from Casper to Findlay, Ohio, succeeding Read. **Richard Englum**, pipe line engineer, Casper, will move up to supervisor of the Regional Pipe Line Engineering Department.

John B. Redpath, project engineer, was named to the newly created position of technical advisor. He will be responsible for developing studies and making recommendations for innovations and modernization of pipe line instrumentation.

William H. Swinbank has been appointed assistant manager of the Supply and Distribution Department of **La Gloria Oil and Gas Company**, subsidiary of **Texas Eastern Transmission Corporation.** He will be responsible for products supply activities related to La Gloria's plants and terminals and for sales and purchases of liquefied petroleum gases at company plants.

W. H. Swinbank

Swinbank, who will headquarter in Houston, has been with La Gloria since 1949. He served as production clerk, chief of production and office manager.

L. Chase Ritts has been named coordinator-crude oil production, purchasing and transportation of **Standard Oil Company of Indiana. Ritts** has been vice president, division manager and director for **Pan American Petroleum Corporation,** affiliate of Standard.

He will be responsible for coordination of activities with Pan American, **Service Pipe Line Company** and **Indiana Oil Purchasing Company.** He joined Pan American in 1947, and in 1955, was named division geologist of Texas-Louisiana Gulf Coast division. He was named manager of exploration operations in the Tulsa office in 1958, and in 1959, was elected vice president, division manager and director at Houston.

Edward Greco, senior research chemist of the Research Department at **United Gas Corporation,** has been elected president of the **National Association of Corrosion Engineers** for 1961-62. **Rolland McFarland, Jr.,** secretary and technical director of **Hills-McKanna Company,** was named vice president and **Charles G. Gribble, Jr.,** district manager for **Metal Goods Corp.,** was re-elected treasurer.

Fred D. Stull, Texas Eastern Transmission Corporation was elected to a three-year term as a director.

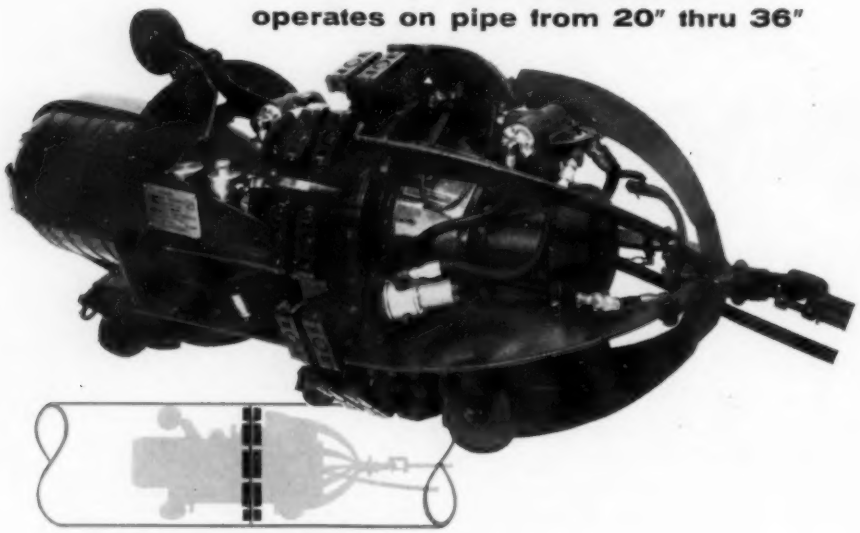
Greco has been a member of the association since 1946. He has served as vice chairman and chairman of the Technical Practices Committee and chairman of technical committees investigating corrosion in oil and gas well equipment.

William Naden, executive vice president of **Humble Oil & Refining Company,** will serve as chairman of the Public Relations Advisory Committee of the **National Association of Manufacturers** during 1961. Naden has been a director of the NAM for the past two years.

COMPLETELY NEW

C-R-C AIR CLAMP*

operates on pipe from 20" thru 36"



THE LINE-UP CLAMP

THAT DOES NOT DAMAGE OR SCRATCH PIPE

CHECK THESE FEATURES:

- Rollers roll pipe into perfect round without friction or sliding of clamp.
- Pneumatically controlled heads operate independently for quick, positive line-up.
- COMPLETELY DEPENDABLE. All working parts completely enclosed, and made from aircraft quality steels for the lowest possible maintenance.

* *Patent applied for.*

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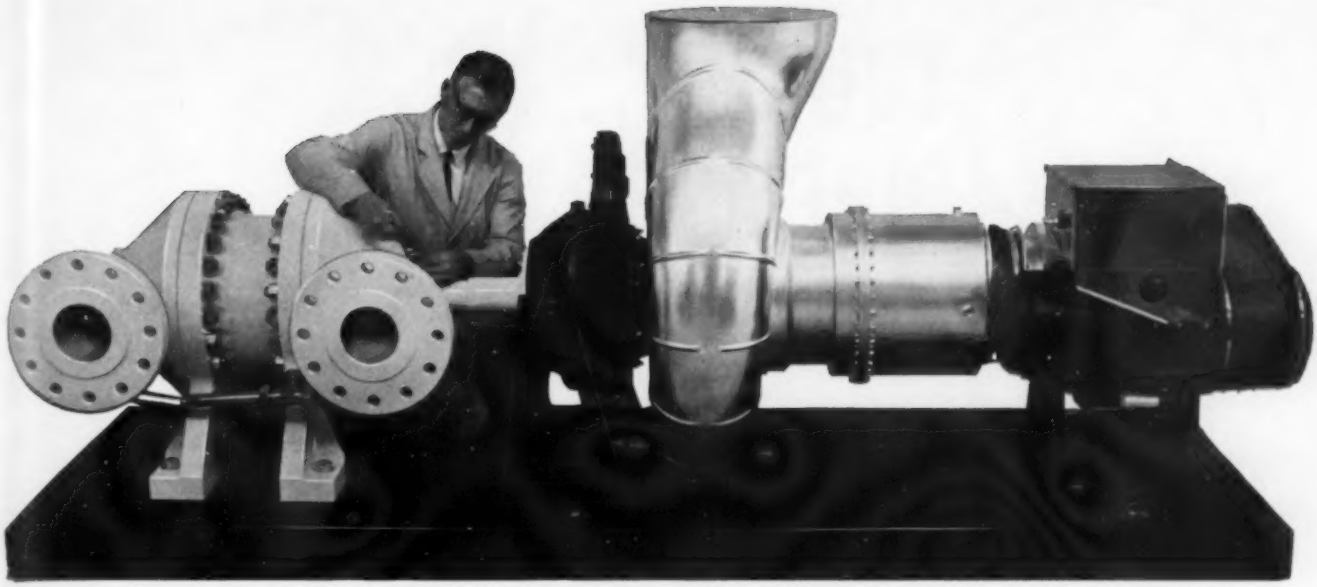


New Solar gas turbine compressor offers low cost, reliability, easy maintenance

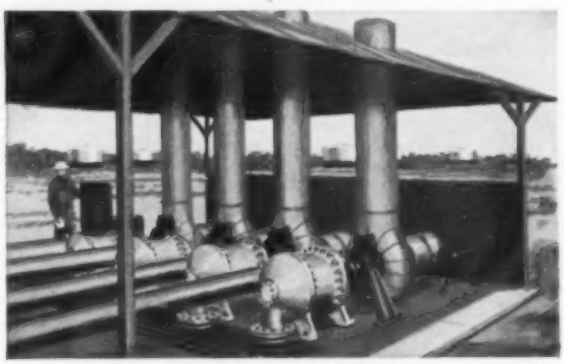
A FUNDAMENTAL ADVANCE in the centrifugal compressor field is available in Solar's new gas-turbine-driven compressor line. These units are particularly adapted for gas compression (both field and main pipeline) and for general industrial use in the low volume range up to 1500 psi.

Long-life gas turbine engines, with rotating speeds of 15,000 to 30,000 rpm, made this breakthrough possible. Driving the compressor directly at turbine speeds has permitted the design of small, high efficiency centrifugal compressors that operate in the range from 75 to 1500 cfm or 5 to 150 MM SCFD.

Features of these compressor packages include: Interchangeable compressor rotors and other parts that allow fast, low cost field changes to meet new flow and pressure requirements. Designed to start and stop in seconds, even by remote control, they are ideal for unattended operation. Small and lightweight, they are easily moved and installed on inexpensive foundations. Maintenance is unusually simple.

Detailed information on Solar centrifugal gas turbine compressors is available. Write to Dept. H-204, Solar Aircraft Company, San Diego 12, California.

Easy transportation for installation or maintenance



Multiple unit installations prevent down time

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A subsidiary of International Harvester Company

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ASBESTOS PIPELINE FELT...

Adheres to the pipe coating or enamel. Protects pipeline against root attack, soil distortion, and trench settlement which can occur from undergrowth in clay or rocky areas or where the soil is alternately wet and dry. Economical and long-lasting Ruberoid Pipeline Felt meets and exceeds the specifications of the American Waterworks Association and the National Association of Corrosion Engineers.

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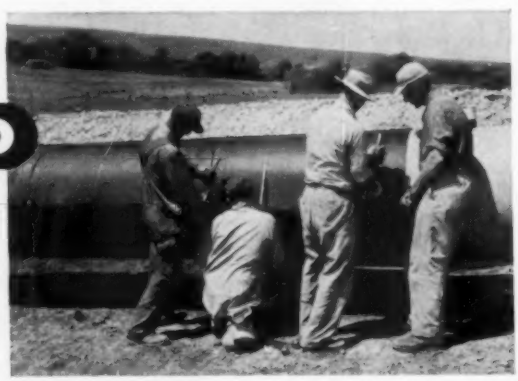
FLEXIBLE ROCK SHIELD...



A durable pipeline protector. Guards pipelines in rocky and swampy areas, and at river, railroad and highway crossings. Also used to make tough saddle pads for river weights or hold-down anchors. Can be applied either in two pieces or by the cigarette wrap method. ½" or ¾" steel strapping with aluminum seals or use of filament tapes insures permanent placement of the shield. Saves time and effort. Light weight cuts freight cost.

For specification details and samples, write The RUBEROID Co., Industrial Products Division, 500 Fifth Ave., New York 36, N. Y.

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PIPELINE PROTECTIVE COVERINGS THAT LAST

P. D. Campbell

Edwin M. Hubach

Edwin M. Hubach and **P. D. Campbell** have been named vice presidents of **Williams Brothers Company.** Hubach will be responsible for domestic and Canadian construction operations with headquarters in Tulsa. Prior to moving to Tulsa, he had been in charge of Williams Brothers operations in Venezuela. He has been with the company since 1942.

Campbell is in charge of operations in Europe, Africa, the Middle East and Far East with headquarters in London. He has been with Williams Brothers since 1948.

J. Howard Marshall, II, has been named president and chief executive officer of **Union Texas Natural Gas Corporation.** He succeeds **Richard T. Lyons,** who has retired. Marshall also becomes a director and member of the executive committee.

Marshall joins Union after serving as executive vice president of the Signal Oil and Gas Company. He had been with Signal since 1952. Previously, he had been president and director of Ashland Oil and Refining Company. From 1931 to 1933, he was assistant dean and assistant professor of law at Yale. He served as a member of the Petroleum Administrative Board in the United States Department of the Interior, chief counsel and assistant deputy administrator for the Petroleum Administration for War and as a consultant to the Secretary of Interior on the Petroleum Defense Program.

Lyons had been president of Union Texas for the past eight years. He will continue to serve as a director and member of the executive committee.

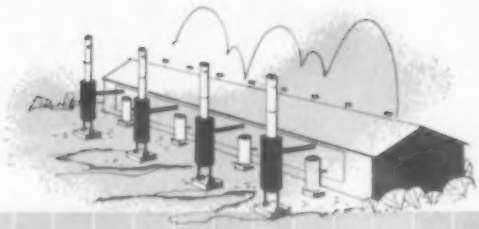
D. M. Bailey

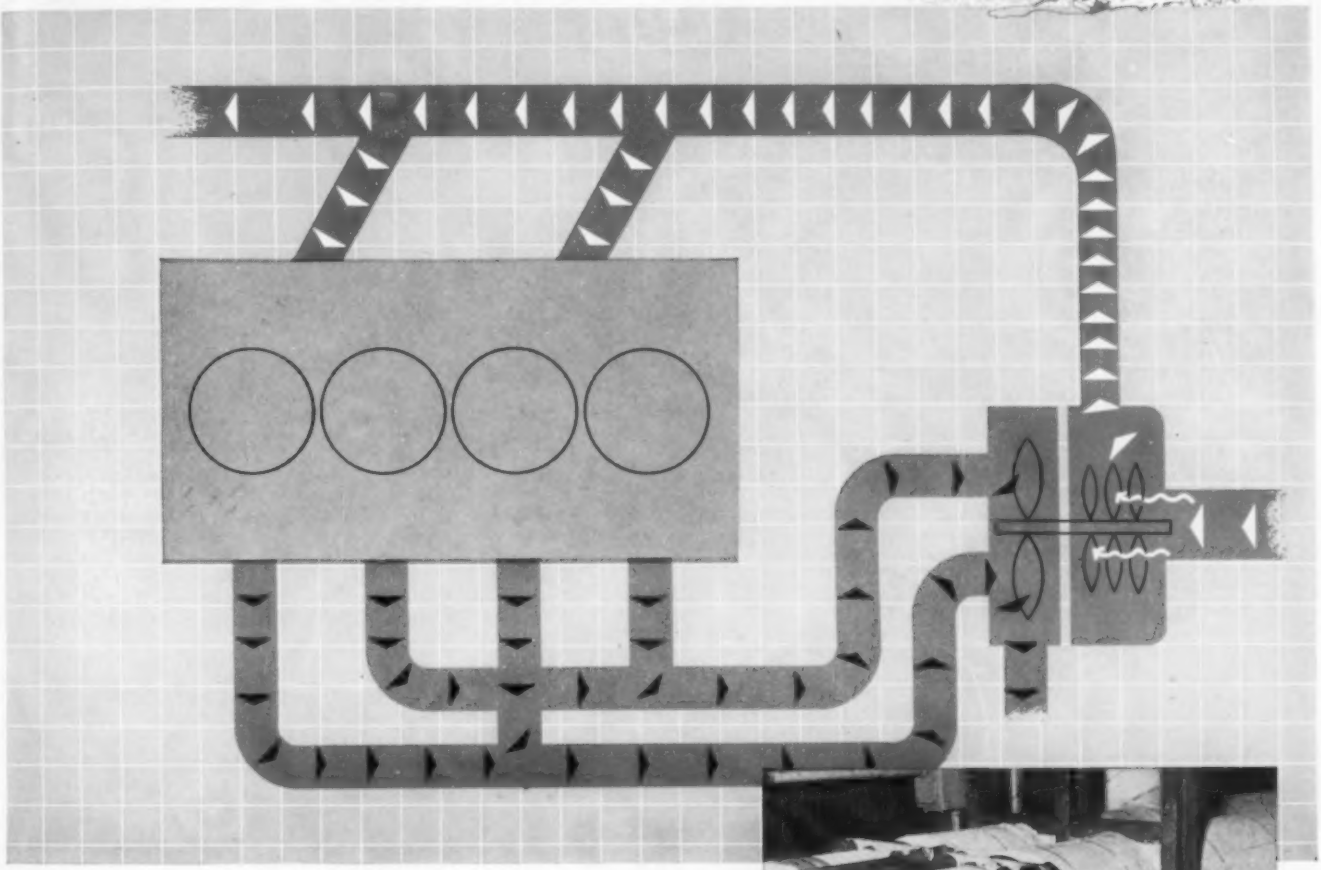
Daniel M. Bailey has been named an executive vice president of **Southern Union Gas Company.** Bailey had been vice president of the Continental-Emsco Company. He joined Continental in 1931 as assistant general counsel. He was named general counsel in 1936, and was made assistant vice president in 1948. He became president in 1950.

John P. Viglini has been appointed chief engineer for transmission division of **Lone Star Gas Company** and **Lone Star Producing Companies.** He has been with Lone Star since 1928, starting as a draftsman. He was named assistant chief engineer in 1955.

Flexonics

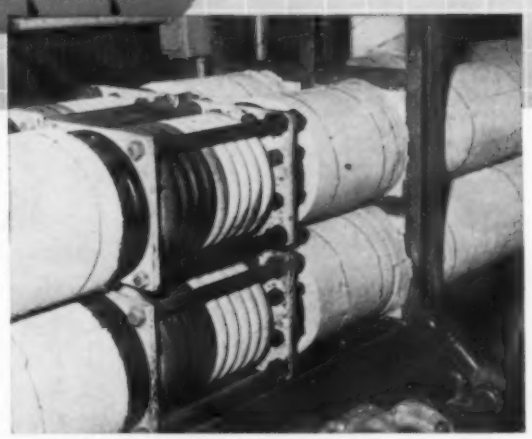
has the engineering experience to help you solve exhaust expansion problems when you turbocharge compressors





Here's a lively subject – *increasing gas pipeline capacity by turbocharging existing compressors in the field.* If you want the answers to the expansion problems that arise when the exhaust piping becomes an integral part of the operating loop, call on FLEXONICS engineers. They have the *specific* experience in this field that can mean actual dollar savings to you.

Write today for your free copy of this easy-to-read report. It tells you the dollars-and-cents facts that led an important pipeline company to a complete turbocharging program.



Special-design FLEXONICS Expansion Joints in the exhaust piping of a newly turbocharged compressor station.

EJMA Member Expansion Joint Manufacturers Association

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Flexonics Corporation
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Maywood, Illinois

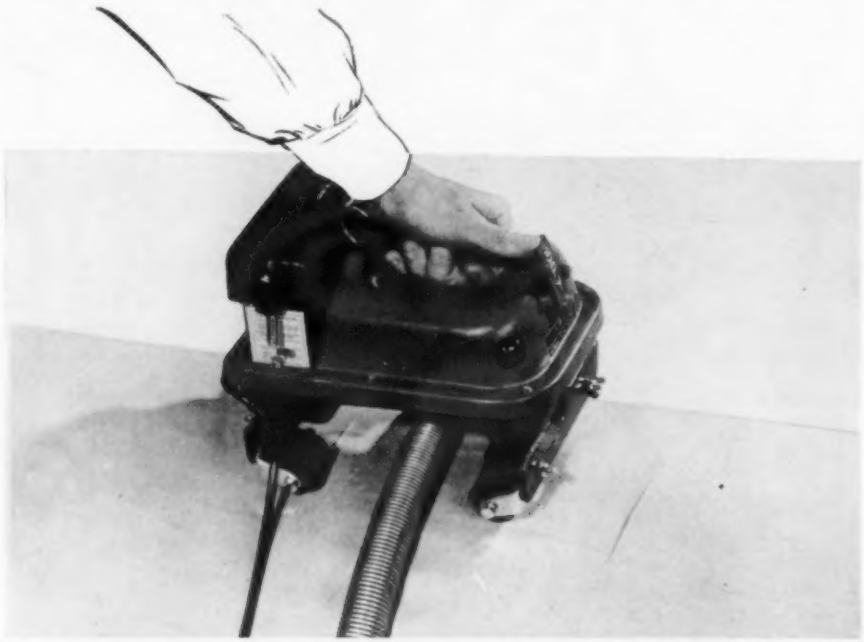
Please send me a copy of Technical Bulletin No. 175, including the detailed report on the engineering and economic aspects of turbocharging existing compressor engines to increase pipeline capacity.

Williams Pressure Service Company Ltd., to specialize in hydrostatic testing of pipe lines, has been formed with headquarters in Calgary. It is an affiliate of **Williams Pressure Service Company** of Shreveport, La.

James Belding, vice president, will be manager of the Calgary office and **John Ench,** vice president, will be manager of the Edmonton office.

Dr. Jerry McAfee, formerly vice president-engineering, for **Gulf Oil Corporation's** Manufacturing Department, has been named to the newly created position of vice president-executive technical advisor. He will report to Gulf's top management the results of technical studies concerning a variety of company activities. He will serve as top management's personal technical representative in preliminary discussions and evaluations of various technical proposals.

Robert J. Owens, Pacific Gas & Electric Company safety administrator, has been named safety engineer. He succeeds **Warren S. Hyde,** who retired after 41 years service. **Glenn A. Merritt** was appointed assistant safety engineer. He had been safety supervisor. Owens has been with the company since 1957, and has worked in the field of safety, radiation protection and occupational health for more than 25 years. Merritt has been with PG&E for 27 years, 19 of those in the Gas Operations Department.



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W. M. Jacobs

Robert Hornby

W. M. Jacobs has been elected president of **Pacific Lighting Gas Supply Company. Robert A. Hornby,** current president, was elected chairman of the board PLGS succeeding **Robert W. Miller** who will resign as board chairman of PLGS but remains president and board chairman of Pacific Lighting Corp., parent company.

Jacobs has been with the company for over 30 years and was elected a senior vice president of PLGS in 1958. He has served as vice president of Pacific Lighting Corp. since 1956, and continues in that position.

Robert L. Kidd has been named chairman of the board and **J. Edgar Heston** was elected president of **Cities Service Oil Co.** (Del.) Kidd has been president since 1956, and will continue as chief executive officer. Heston, who has been president of **Arkansas Fuel Oil Corp.** since 1956, will continue in that position.

W. A. Strauss has been named president and principal operating officer of **Northern Natural Gas Company.** He succeeds **John F. Merriam,** who will remain as chairman of the board and chief executive officer of the company.

W. A. Strauss

Strauss also was elected a member of the board and a member of the executive committee. **A. B. Dilworth,** senior vice president, was named a member of the board and executive committee. Strauss has been with Northern for 13 years and served as administrative vice president for years and later became executive vice president prior to his recent promotion.

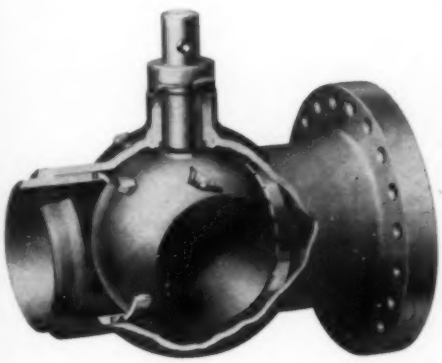
John S. Shaw, Jr., has been named vice president-financial for **Southern Natural Gas Company.** He will succeed **Howard M. Erskine,** who has retired after 30 years service.

Shaw has been associated with Ingalls & Snyder for the past eight years. Previously he had been an officer of the Bank of New York and held other positions in commercial banking.

J. R. Lyne, vice president of **Industrial Gas Supply Corp.,** has been elected a director and general manager. Industrial Gas is a wholly owned subsidiary of **Stone & Webster, Inc.**

8" x 6" x 6" 600 lb. ASA Flanged X Welding End Ball Valves in Pipeline meter run

CAMERON BALL VALVES



NEW — FOR GENERAL USE — for Pipe Lines — Chemical Refining and Gas Processing Plants — Oil Well Drilling and Producing

These valves, with the exclusive rotating seats, handle the most abrasive and corrosive fluids — cannot freeze — cannot develop excessive body pressure; they provide up-stream seating, double block and bleed, all with unbelievably easy operation.

They can be supplied in any material, size 2" to 36" and larger to required working pressures and with any type or style of operator desired. Cameron Ball Valves can be delivered from factories located in the United States, Canada, Mexico, England and France.

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WHO'S MEETING WHERE

February

Southwestern Legal Foundation Institute on the Law of Oil, Gas and Taxation, Southwestern Legal Center, Dallas, February 8-10.

National Society of Professional Engineers, winter meeting, Hotel Fort Des Moines, Des Moines, Iowa, February 9-11.

NACE, short course, Shreveport Section, Centenary College, Shreveport, La., February 14-15.

Pipe Line Contractors Association of Canada, seventh annual convention, Empress Hotel, Victoria, B. C., February 23-25.

NGAA, South Louisiana Regional meeting, Lafayette Petroleum Club, Lafayette, La., February 24.

American Institute of Mechanical Engineers, annual meeting, Chase & Park Plaza Hotels, St. Louis, February 26-March 2.

March

ASME, Gas Turbine Power Division, cosponsored by the Department of Defense, sixth annual conference and exhibit, Shoreham Hotel, Washington, D. C., March 5-9.

NACE, seventeenth annual conference, Hotel Statler, Buffalo, N. Y., March 13-17.

New England Gas Association, annual meeting, Hotel Statler, Boston, March 15-17.

NGAA, 40th Annual Convention, Baker Hotel, Dallas, March 15-17.

AGA General Management Section conference, Frances-Marion Hotel, Charleston, S.C., March 20-22.

American Society for Metals, 12th western metal congress and exposition, Pan American Auditorium, Los Angeles, March 20-24.

American Power Conference, Sherman Hotel, Chicago, March 21-23.

Mid-West Gas Association, annual meeting, Sheraton-Fontenelle Hotel, Omaha, Neb., March 27-29.

University of Oklahoma, Schools of Petroleum and Gas Engineering, gas conditioning short course, Oklahoma Memorial Union Building, University of Oklahoma, Norman, Okla., March 28-29.

April

University of Oklahoma, School of Mechanical Engineering, short course of industrial engines, University of Oklahoma, Norman, Okla., April 6-7.

ASME, oil and gas power conference and exhibit, Jung Hotel, New Orleans, April 9-13.

ASME, maintenance and plant engineering conference, Bancroft Hotel, Worcester, Mass., April 10-11.

PIEA-PESA, annual meeting, Galveston, Texas, April 11-13.

University of Oklahoma, Southwest Gas Measurement Short Course, North Campus, Norman, Okla., April 18-20.

American Welding Society, meeting and show, Commodore Hotel, New York, April 18-20.

AIME Society of Petroleum Engineers, East-Texas, Louisiana, Arkansas gas technology symposium, Tyler, Texas, April 20-21.

Illinois Society of Professional Engineers, annual convention, Peoria, Ill., April 20-22.

Southern Gas Association, annual convention, New Orleans, April 24-26.

API, Division of Transportation, annual meeting, Chase Park Plaza Hotel, St. Louis, Mo., April 26-28.

NGAA, Oklahoma regional meeting, Lake Murray Lodge, Ardmore, Okla., April 28.

May

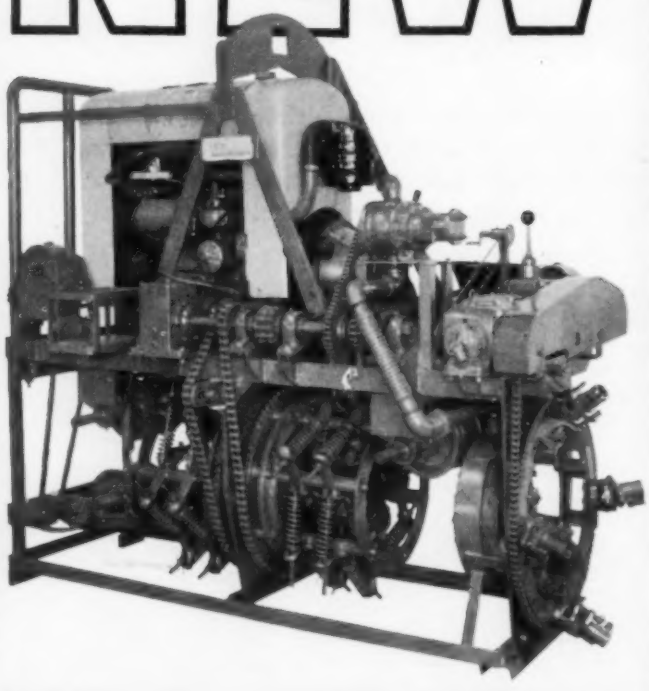
Pacific Coast Gas Association, transmission conference, Biltmore Hotel, Santa Barbara, Calif., May 4-5.

NGAA, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, May 19.

ISA, AIEE, ARS, IAS, IRE, National Telemetering Conference, Chicago, May 22-23.

AGA, Operating Section, transmission, annual meeting, Brown Palace, Denver, May 25-26.

NEW



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CLEANING & TAPE WRAPPING MACHINE

AVAILABLE IN FOUR MODELS

The New Crose Combination Cleaning and Tape Wrapping Machine has variable speed tape wrapping head; built-on blower to remove dust from pipe prior to applying tape, and baffles incorporated into machine's design to protect wrapping area from dust. Four models — comparable to the Crose Cleaning and Priming Machine — handle these pipe sizes: 2″-4″; 4″-16″; 16″-32″ and 34″-40″.

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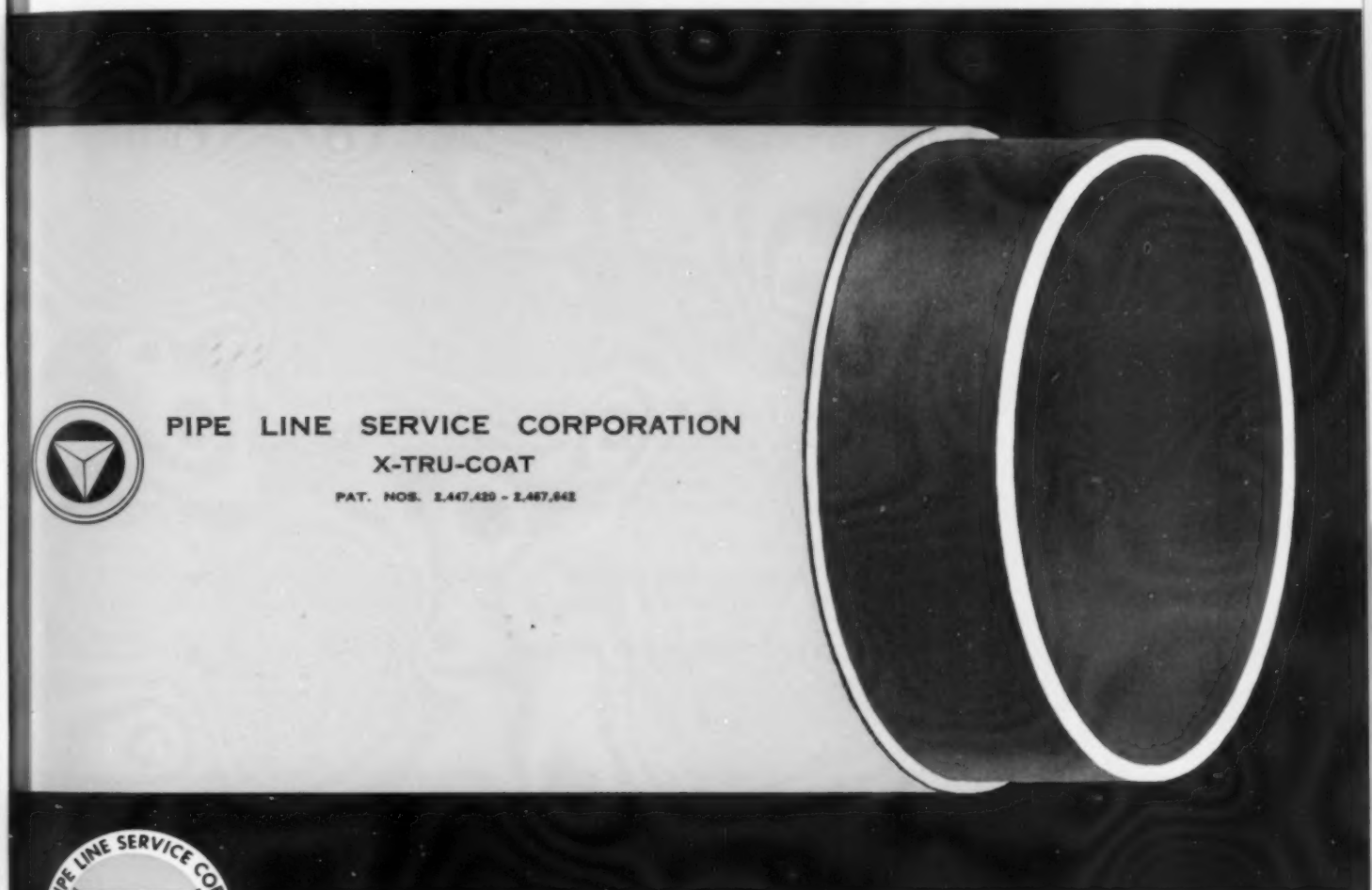
2765 DAWSON RD., TULSA, OKLA., Phone WEbster 6-2171 BRANCH OFFICES: Houston, Texas • Elizabeth, New Jersey • IN CANADA: CROSE-PERRAULT CANADA, LTD., Edmonton, Alberta • Toronto, Ontario • EXPORT OFFICE: New York, N. Y.

PIPE LINE SERVICE CORPORATION

now offers

X-TRU-COAT



Contributing once again to the progress of the Gas and Oil Industry, Pipe Line Service Corporation, pioneer in the field of steel pipe protection, offers you the application of X-TRU-COAT.

X-TRU-COAT is a High Density Polyethylene extruded on steel pipe over a pressure sensitive adhesive, produced under the Dekoron process.

Pipe Line Service is the first Independent Coating Company to apply X-TRU-COAT, and is now offering *Immediate, Unlimited Production* at our Sparrows Point, Maryland plant on pipe sizes ½" through 4½" O.D. pipe. X-TRU-COAT will soon be available at our new Youngstown, Ohio plant (presently under construction) in early Spring, 1961.

For prices and complete information about this new service, call or write Pipe Line Service Corporation, P.O. Box 318, Franklin Park, Illinois.

Pipe Line Service Corporation

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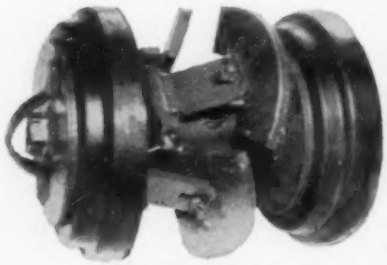
General Offices and Plant: Franklin Park, Ill.

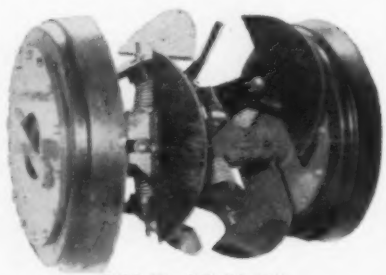
Quality pioneers in coating and wrapping pipe for over a quarter century

If you have a special problem...

we can help you!



TYPE HI—6" TO 18"



TYPE HI—20" TO 36"

TYPE HI—6" to 36"

The latest development in pipe cleaning tools.

CONSTRUCTION

These springs extend through the center of the unit to blades on the opposite side of the unit which gives it a maximum of flexibility. The heavy springs on this unit help to keep it centered in the pipe supporting its own weight which will give far greater cup life.

DESIGN

This unit is ideal for first run on new construction, or for extremely corroded pipelines.

PIPELINE CLEANERS CO.

FORT MADISON, IOWA
PHONE DRake 2-2051

What's Happening among SERVICE and SUPPLY MEN

Valves for Middle East Pipe Line

Valves for a 600-mile crude line extending from Kirkuk, Iraq, to Tripoli, Lebanon, are being shipped from W-K-M's Houston plant to the overseas job. On hand as valves leave plant are Marvin Hurley, executive vice president of Houston Chamber of Commerce; J. S. Downs, division president; and B. J. Gross, division vice president for marketing.

I. K. Ackmann Promoted By Insley Manufacturing Company

I. K. (Ken) Ackmann has been promoted by Insley Manufacturing Company to manager, eastern-central sales. He has been with Insley for 23 years starting in the Service Department. He became district representative and later was named assistant sales manager, the position he held prior to his new appointment. R. J. Boatman, who formerly held that position, will remain with Insley as a special sales representative.

I. K. Ackmann

Caterpillar Subsidiary Acquires Plant Facilities

Caterpillar France, S.A., subsidiary of Caterpillar Tractor Co., has established its manufacturing plant in Grenoble, France. The company obtained a 150,000-square-foot facility from Group Richier, French manufacturer.

Caterpillar Overseas, S.A., of Geneva will hande sales of French subsidiary's products outside of France. W. J. Bornholdt is president of the company. Personnel include C. L. Boyd, accounting; H. A. Cornelius, purchasing; Elmer Dixon, manufacturing; Arthur Francois, planning; M. B. Holland, engineering; E. L. Schuller, planning, and W. W. Sellers, quality control.

Childress Named Controller Of Southern Pipe Division

Frank D. Childress has been named controller of Southern Pipe Division of U. S. Industries. Jesse A. Duffey has been promoted from office manager to assistant controller and George F. Gray becomes office manager. Childress has been with the company 20 years. Duffy joined Southern in 1950, and Gray has been with the firm since 1957.

Grove Valve & Regulator Names Two Vice Presidents

Harold Wolpman has been named a senior vice president and Walter L. Connally has been appointed vice president-manufacturing for Grove Valve and Regulator Company. Wolpman had been vice president-plant engineering for the Oakland-based company. He has been with Grove since 1937. Connolly previously was director general of Grove France, Paris subsidiary. Connolly has been with the company since 1944. He was named chief engineer prior to his position with Grove France. He will be headquartered in Oakland, Calif.

W. E. Skinner Joins Intercontinental Enterprises

W. E. Skinner has joined Intercontinental Enterprises and will be responsible for the merchandising of Heliweld spiral pipe welding machinery. Skinner previously was with Westinghouse and Zenith Radio Corporation.

INDUSTRY-WIDE USE

BUILT ON OUTSTANDING PERFORMANCE

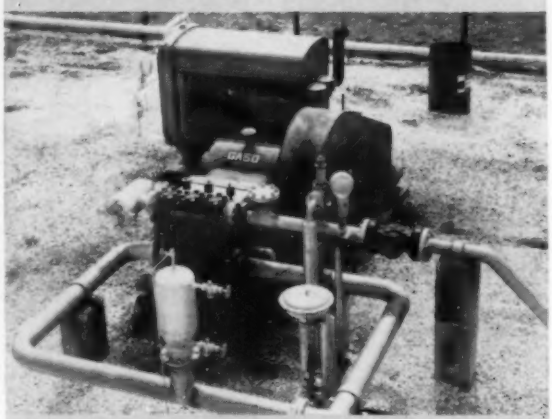
Not too long ago Gaso Pumps were known principally for their work in pipe line service.

Today they are specified in ever increasing volume by all branches of the industry.

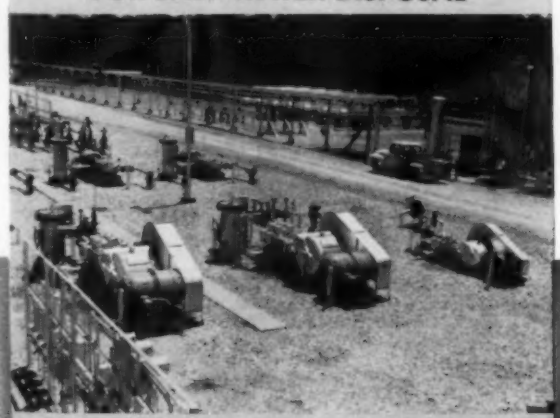
The reason is obvious: Engineers concerned with water flooding, salt water disposal, oil well cementing, oil well acidizing and fracturing, LPG underground storage, mine water disposal and other operations involving pumps are just as interested as pipe line engineers in the extra years of trouble-free service which have become a Gaso trademark.

Performance speaks a universal language, and it's performance upon which Gaso leadership is built.

GASO PUMPS IN PIPELINE SERVICE



GASO PUMPS
FOR SALT WATER DISPOSAL



GASO PUMPS IN LPG SERVICE

GASO PUMPS
for every oil industry need

SEND FOR OUR
1960 - 1961
CATALOG

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Shreveport, La., Odessa, Texas, Brookhaven and Tinsley, Miss. – W. L. Somner Company
Houston, Texas – Texas Pump & Compressor Company
Wichita Falls, Texas – Pump Engineering Co.
Evansville, Ind. – Hague Equipment Co., Inc.
Long Beach and Bakersfield, Cal. – Power Pumps, Inc.
Casper, Wyoming – Lufkin Foundry & Machine Co.
Edmonton, Alberta – Lufkin Machine Co., Ltd.

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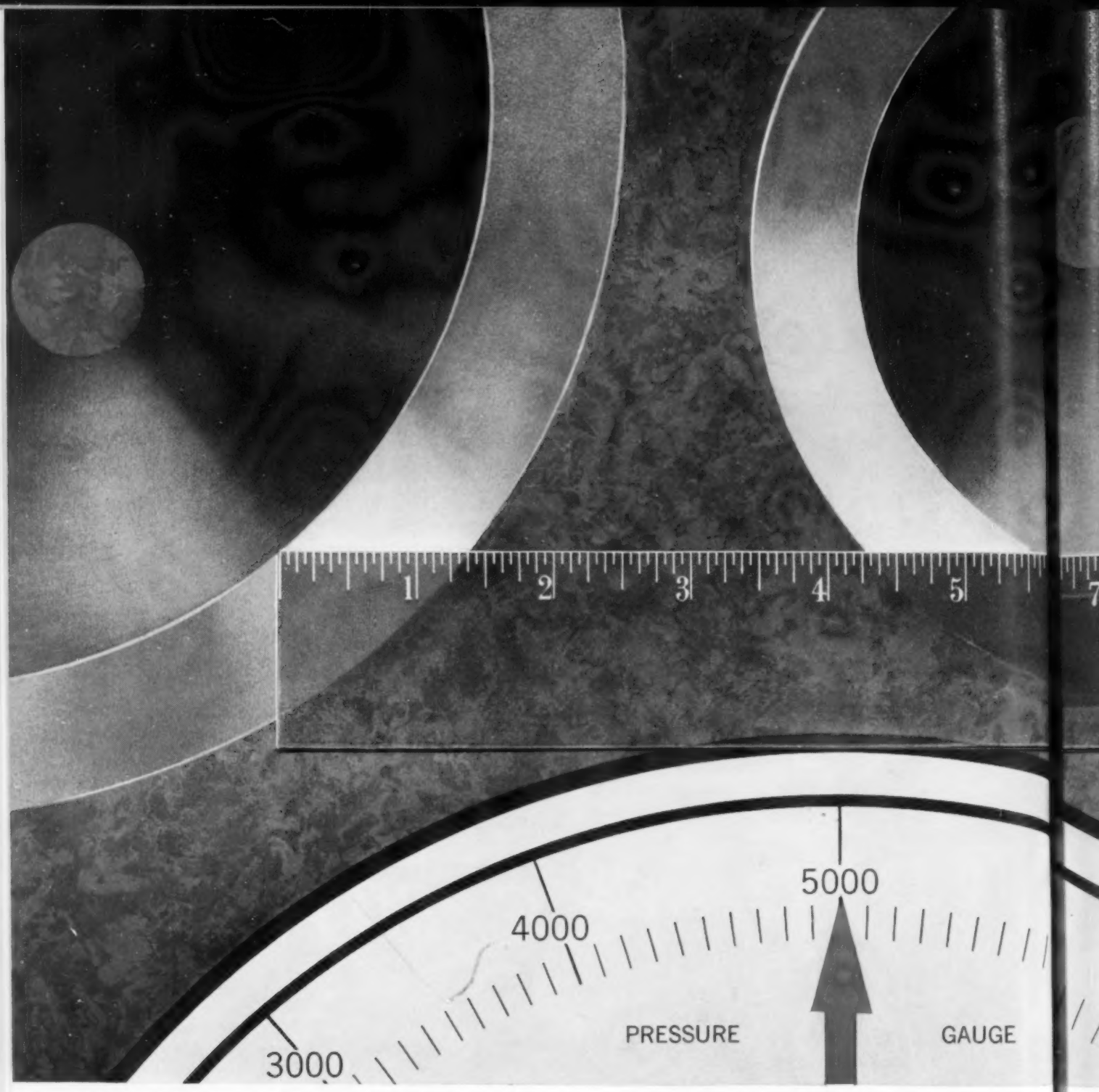
CRUDE OIL GATHERING LINES · CRUDE OIL PIPE LINES · PETROLEUM PRODUCTS PIPE LINES · GASOLINE PLANTS-ABSORPTION OIL · LPG UNDERGROUND STORAGE · WATER FLOODING · OIL WELL CEMENTING · OIL WELL ACIDIZING AND FRACTURING · SMALL VACUUM SYSTEMS

ASO PUMP & BURNER MFG. CO. First and Lansing Streets, Tulsa Oklahoma · Export Office: Empire State Building, New York, N. Y.



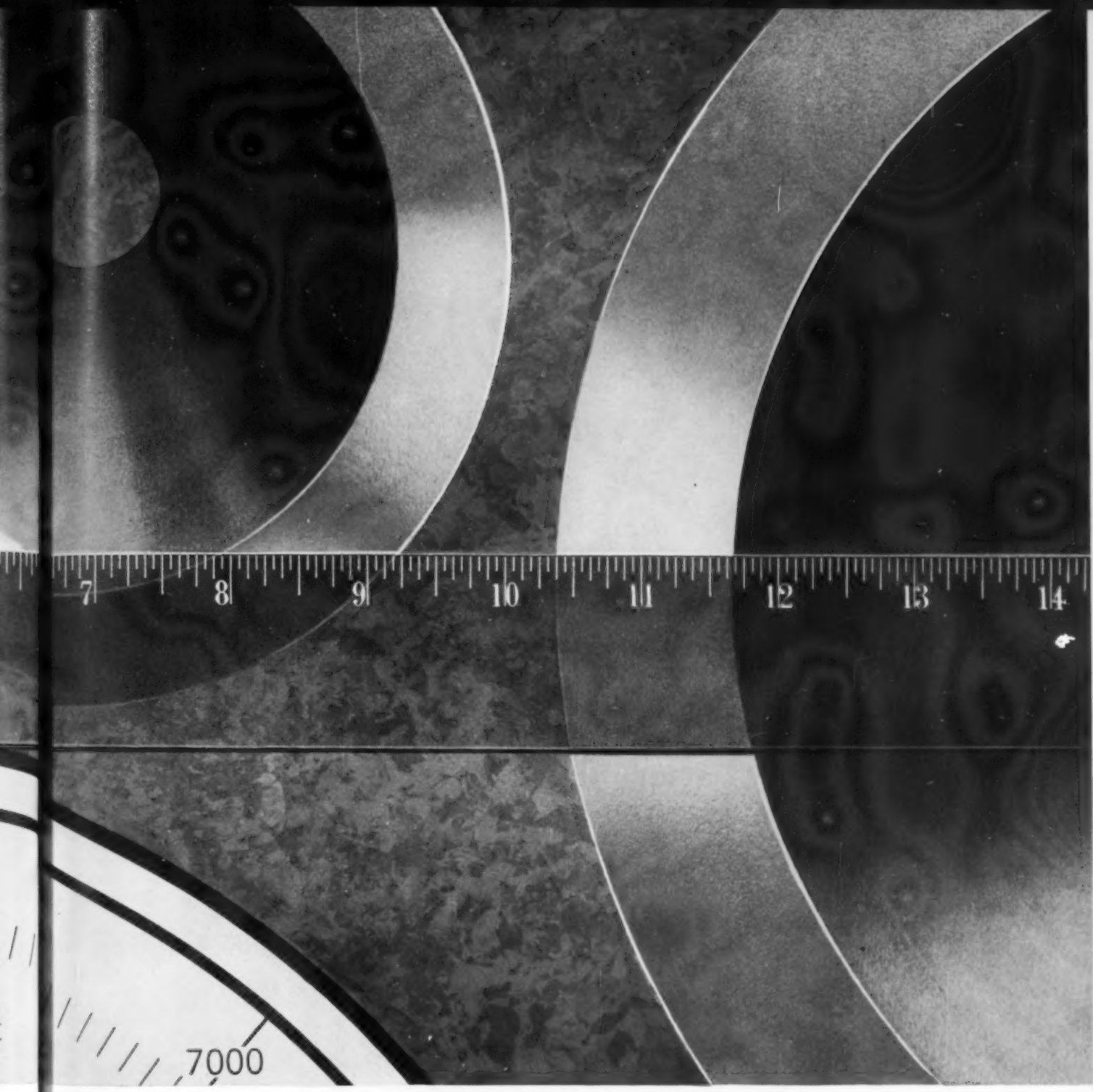
It takes cannon-barrel pipe to store gas at 5,000 psi

North of the Susquehanna River near Renovo, Pennsylvania, is a depleted gas reservoir known as Leidy Field. It has just been converted into an underground gas storage field. The field has a total of 85 wells and is roughly 13 miles long and 7 miles wide.

To store gas in this natural reservoir when completed requires an injection pressure of 5,000 psi at the wellhead. This storage field provides for a peak withdrawal of 800 million cubic feet each day and an average withdrawal of 400 million cubic feet per day during the winter season.

Seamless Steel Line Pipe was selected for this

This mark tells you a product is made of modern, dependable Steel.



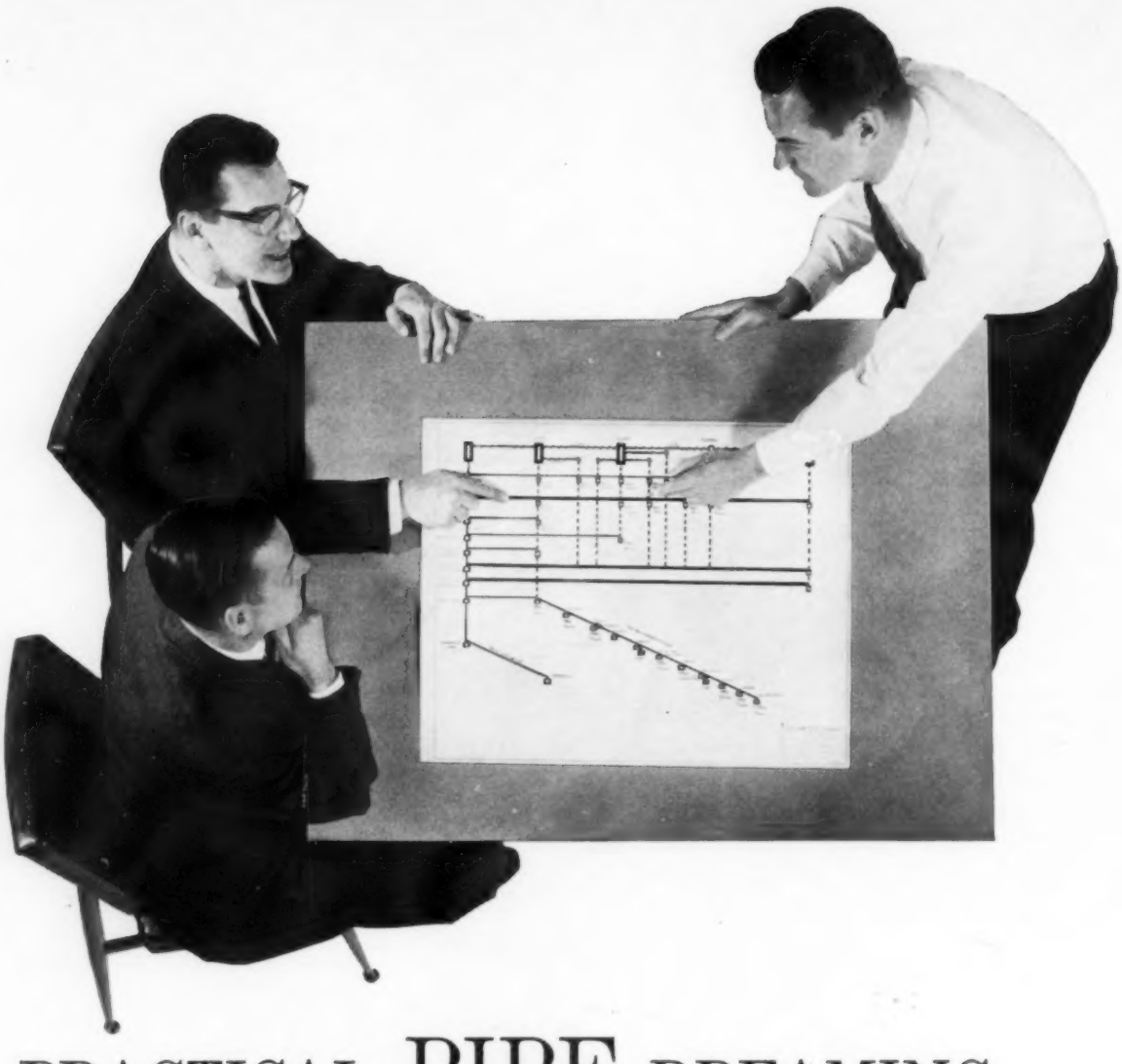
project, because the high pressures demanded strong, reliable pipe with almost cannon-barrel thickness. Pipe walls ranged up to 1.312" in thickness in pipe size 6⅝-inch to 12¾-inch.

USS National Seamless Steel Line Pipe met these requirements. It is ideal for lines that handle gas, liquids and solids. It's available in a complete range of wall thicknesses, steel analyses, and in diameters up to 26 inches—USS National Electric-Weld Line Pipe up to 36 inches. Write for information on our products, services and facilities. National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York



PRACTICAL PIPE DREAMING

Stromberg-Carlson's unique new approach to Pipeline Communications

Your new communication system—or the efficient modernization of your present one—can begin in a meeting like the above.

The locale is the Stromberg-Carlson division of General Dynamics—specialists in telephone communication since 1894.

The men are specialized engineers who have devised a fresh, practical, waste-eliminating communication system *specifically for pipelines.*

Modular in application and amazingly versatile, it can be adapted to meet any requirement—including some truly "unusual" specifications we've handled recently!

A letter, wire or phone call to Stromberg-Carlson's PIPE-DREAMING department, 127 Carlson Road, Rochester 3, New York, will reserve you a chair in an early session.

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**

We're proud to have our equipment serving many of the outstanding oil and pipeline companies in America. Ask us to tell you who they are.

E. G. Vail

R. W. Briska

Graver Tank & Mfg. Co. Announces Three Appointments

Graver Tank & Mfg. Co. has appointed Alan Law and R. W. Briska to positions in the newly established Industrial Engineering department and E. G. Vail has been promoted to plant manager, Houston. Law becomes chief industrial engineer and heads the new department. Previously he was plant manager at Houston. Briska becomes plant engineer. Plant engineering will be incorporated under industrial engineering under the direction of Briska. Vail moves to Houston from Tulsa.

Alan Law

APCO Announces Appointment Of U.S.-Mexico Representatives

APCO, Division of Textron, Inc., announces the appointment of eight representatives covering active oil and gas areas throughout the United States and Mexico. They will handle sale of jet stream pressure regulators and check stream dump valves.

Kerr Engineered Sales Co., Pittsburgh, will cover Western Pennsylvania, West Virginia, Ohio and Michigan; Becker Engineering and Supply Co., Chicago will handle Illinois, Indiana, Iowa and Wisconsin; Leroy E. Rogers Co., Clearwater, will cover Florida; Scott Equipment Co., Denver, is assigned to Colorado, Wyoming and Montana; R. G. Wetzel Co., Tulsa, will cover Oklahoma, Texas Panhandle and parts of Kansas and Nebraska; Petroleum Tool and Supply Co., Farmington, N. M., will handle four corners area of New Mexico, Arizona, Colorado and Utah; and W. J. Sommers Company, Inc., Buffalo, N. Y., will operate in Western New York. Daniel de Mexico, S. A., Mexico City, will represent APCO in Mexico.

Cal-Metal Pipe Corporation Announces Two Appointments

Harmon Cutler has been promoted to plant manager and Howard E. Midkiff has been appointed sales manager for Cal-Metal Pipe Corporation. Cutler was superintendent of the Cal-Metal plant becoming plant manager. He has been with the company since 1952.

Midkiff was a branch manager of an equipment company in Tulsa and employed by a major oil and refining company in Oklahoma and New Mexico.

BONNEY WELDOLETS

cut corners safely...

ON ALL 90° BRANCH PIPE CONNECTIONS

Competitive economic times like these make cost cutting mandatory. Reduce piping costs by using Weldolets instead of welding tees for all full size and reducing branch connections. Contractors and owners are saving thousands of dollars on piping jobs by switching to Weldolets. Are you? Write for information.

BONNEY

also exclusive manufacturers of
WELDOLETS®
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CARBON STEEL
STAINLESS
ALLOY
for all services

BONNEY FORGE AND TOOL WORKS, ALLENTOWN, PA.

For more data on advertised products, use Readers' Service Cards, last page.

High-output TD-15 Paywelder welding of mile of 36" gas

—for Sharman, Allen, Gay & Taylor,

Two International Paywelder units keep eight welders busy making stringer bead and hot-pass welds on a Sharman, Allen, Gay & Taylor, Inc., gas line-looping contract in Mississippi. The welding gang averages 150 joints, a full mile, per 10-hour day. This contractor gets the same efficiency from a second Paywelder team on another spread.

"The TD-15 Paywelder has proven to be the best welding rig of its type, by far, in my experience," states Pipe Gang Foreman B. L. Northam. "I've had them on really rough right-of-way—and flotation and balance are excellent. Plenty of Paywelder power means continuous output for fast, even welding, with efficient speed."

Factory engineered and all factory built, the high-output, 325-amp Paywelder is powered and carried by the 6-cylinder International TD-15 crawler tractor —equipped to produce 120 intermittent hp. Unit consists of two Lincoln dual welders with four welding leads—and is V-belt driven from the front pto.

You can mount your clamp-actuating air compressor on the strong front extension platform—and drive it from front power take-off extension, that's standard Paywelder equipment. Carry extra pipe clamp and supplies on large rear platform (also standard equipment).

You can "shoe" this 74-inch-gauge unit with 24-inch tracks—to hug hillsides, tread surely over bogs. Thorough sealing of vital parts excludes trouble-making grit and moisture.

Team "sparks" line joints per day

Inc., Houston, Texas

Spot a Paywelder on your spread and compare! Measure the economies of combining four welders and compressor in a one-man operated, pipeliner-proven, big-capacity rig. Let your International Construction Equipment Distributor demonstrate on your spread.

International*® *Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.
A COMPLETE POWER PACKAGE

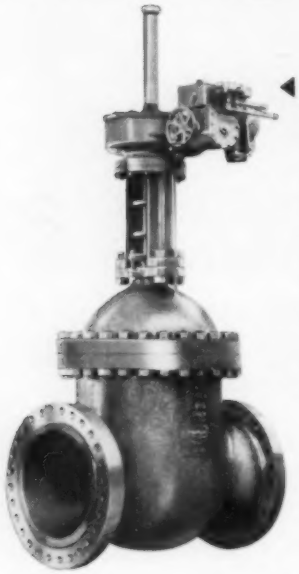
International TD-15 Paywelder, equipped to produce 120 intermittent hp, easily delivers current needed for four welding leads—and has reserve power to drive the 3½ x 2½ Quincy compressor from front pto, to operate a CRC pipe clamp.

Each of these two International TD-15 Paywelder units powers four 325-amp. welding leads. The front Paywelder carries and powers (from pto) a front platform-mounted clamp actuating compressor. And the rear Paywelder tows a sled-mounted unit equipped with two 200-amp. welding leads. Contractor is looping a 36-inch gas line between Seminary and Soso, Mississippi—for Transcontinental Pipeline Corp.

Check this DARLING gate valve trio for

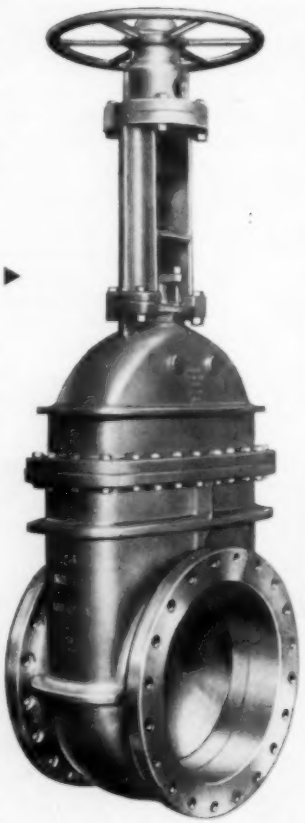
UNMATCHED ADVANTAGES

in every oil, gas and petrochemical service



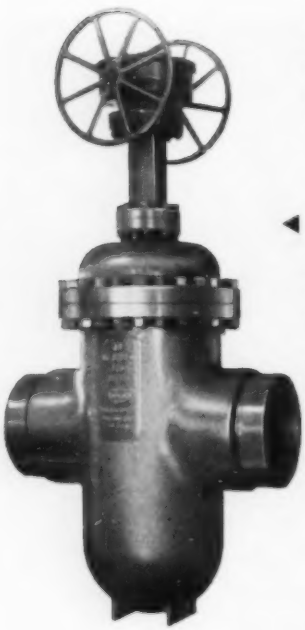
◀ DARLING FULLY REVOLVING DOUBLE DISC GATE VALVES

—famous for *consistently* trouble-free operation in all kinds of service. Revolving disc principle assures easy operation, surer closure, minimum friction, automatic seating compensation, extreme life with minimum maintenance. Ask for Catalog 57.



DARLING ALUMINUM ALLOY GATE VALVES ▶

—featuring all the advantages of the above revolving disc principle, *plus* new economies in the handling of "problem" fluids and gases or wherever aluminum piping is used. Ask for Bulletin SLS 5801.



◀ DARLING-McEVOY SELF-SEALING CONDUIT VALVES

— the *only* conduit gate valve with *sealant gasketing* between gates and seats. Every closure leakproof! This and other advantages proved by outstanding performance on major lines. Get *all* the facts. Ask for Catalog 57.

Whatever the service, in any phase of pipelining, gathering or processing, these Darling gate valves offer worthwhile features and advantages unobtainable in other valves. The catalogs referred to above are available to give you the pertinent facts.

DARLING VALVE & MANUFACTURING CO.

Williamsport 27, Pa.

Manufactured in Canada by
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

Solar Aircraft Co. Names W. D. Bryson Vice President

W. D. Bryson has been elected a vice president of Solar Aircraft Company, subsidiary of International Harvester Company. He will have responsibility for coordination of Solar's engineering and production activities in a staff capacity reporting to the president.

Bryson has been manager of manufacturing research at Harvester since April 1955.

J. A. Harrison

Howard Trusler

Hill Hubbell Company Expands Sales Force

Hill Hubbell Company announces three appointments in its sales organization. Jack A. Harrison has been promoted from district sales manager, southeastern United States, to general sales manager. Howard Trusler has joined the company as district sales manager covering Ohio, West Virginia, Kentucky and parts of Pennsylvania. M. M. Bowen, Jr., has been appointed district sales manager for states of North and South Dakota, Nebraska, Kansas, Iowa, Missouri and Minnesota. Harrison joined the company in 1954, and was general purchasing agent before entering the Sales Department. Trusler had been Houston regional sales manager for Pittsburgh Coke and Chemical Company before joining Hubbell. Bowen came to Hubbell in 1956. This expansion follows the recent agreement whereby Hubbell has been licensed by Republic Steel Corp., to apply X-Tru-Coat.

M. M. Bowen, Jr.

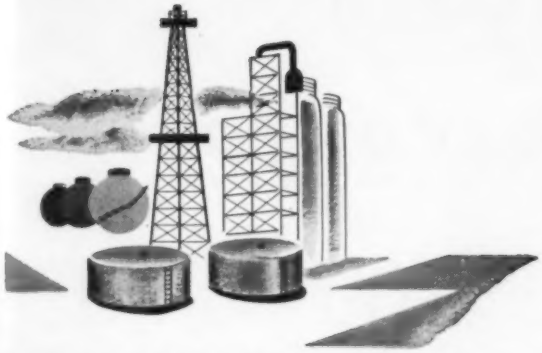
Clark Brothers Appoints Foster to Dallas-Midland Area

A. J. Foster has been named parts salesman and service supervisor for Clark Bros. Co. Dallas-Midland district. His headquarters will be located in Albuquerque, N. M. Foster joined Clark in 1948, and prior to his new assignment he worked in the Service Department, both at Clark plant in Olean and in various field assignments.

Jones & Laughlin Supply Transfer Two Salesmen

Jones & Laughlin Supply Division has transferred two salesmen, L. K. Greer of Borger, Texas, has been moved to San Antonio. F. P. Crahan, salesman at Beaumont, has been transferred to Cameron, La.

Greer joined the company in 1956, and



PETROLEUM INSTALLATIONS

STOP WEEDS

with safe, effective

SIMAZINE or ATRAZINE

pre-emergence pre- or post-emergence

HERBICIDES

Economical, long residual Geigy herbicides save time and money—do the job right the first time. One application stops weeds before they start—gives you season long control.

Safe to humans and animals, non-irritating to skin, non-flammable, non-corrosive to equipment. Safe to use on valuable land. Available through leading distributors.

FREE BROCHURE: *New full color booklet contains complete directions, diagrams, applications and other useful data for both Simazine and Atrazine.*

MAIL COUPON TODAY

GEIGY AGRICULTURAL CHEMICALS,
Division of Geigy Chemical Corporation
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Send free weed control brochure to:

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*City*_____ *State*_____

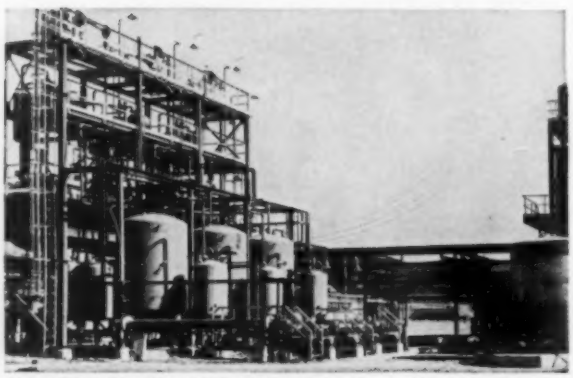
Geigy *ORIGINATORS OF DDT INSECTICIDES*

Why you can be sure...

Celanese Cellulubes are the best functional fluids you can use

There are four practical reasons behind our claim that *you just can't buy better fire-resistant hydraulic fluids or air compressor lubricants than Celanese Cellulubes.*

1



BASIC PRODUCER—Celanese was the *first* to produce phosphate esters . . . and is the *only* producer currently marketing a series of industrial phosphate ester lubricants. Experience has demonstrated that we now have one of the best equipped plants in the country.

2

APPLICATION ENGINEERING—Our files contain facts about hundreds of successful Cellulube applications in many industries. Celanese engineers have the experience and interest to help you make the most of these functional fluids.

3

QUALITY CONTROL—Celanese zealously guards the quality of Cellulubes by a system of constant checks and controls. Physical and chemical properties are strictly maintained within exacting limits to assure you of optimum performance for fire-resistance and lubrication. What's more, Cellulubes have passed the most rigorous tests that the military and some of America's largest companies could devise.

4

TECHNICAL ASSISTANCE—Our technical staff provides assistance to see that the changeover from conventional fluids to Cellulubes is made as quickly and easily as possible. In many cases, our salesmen provide all necessary conversion know-how.

Fire-resistant Cellulubes are available in *six* controlled viscosities. Not only are they outstanding for the prevention of fire and explosion, but they give overall wear protection comparable to premium petroleum oils. Get the complete facts by using the coupon below. Celanese® Cellulube®

Celanese Chemical Company, Dept. 576-B
180 Madison Avenue, New York 16, N. Y.

Please rush me a copy of your manual on Cellulubes as
☐ hydraulic fluids ☐ synthetic lubricants

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

Celanese CHEMICALS

FM Factory Mutual-Approved (Cellulubes 150 and 220)

Bureau of Mines-Approved #30-2

Celanese Chemical Company is a Division of Celanese Corporation of America.
Canadian Affiliate:
Canadian Chemical Company Limited, Montreal, Toronto, Vancouver.
Export Sales:
Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Ave., New York 16.

has been at Borger since 1958. Crahan came to the company in 1955, and was assigned at Beaumont in 1957.

C-B/Southern Moves Facilities to Houston

C-B/Southern, a division of Cooper-Bessemer Corporation has announced a transfer of its manufacturing operations of a short stroke compressor line to Houston.

Manufacturing and marketing of the Type AM compressor line are now centered in Houston. Central parts warehousing will be located in Houston and will feed Cooper-Bessemer's organization.

Gardner-Denver Company Names Estrop Representative

J. M. Estrop has been named exclusive representative for all Gardner-Denver Company petroleum industry products in the Republic of Mexico. Estrop has been manager of Cia Pan Americana Comercial, S.A.; material agent for Petroleos Mexicanos and material superintendent for Cia. Mexicana de Petroleo-El Aguila, among others.

CLASSIFIED ADVERTISING

WORLD-WIDE OPPORTUNITIES

FOR

Outstanding Pipe Line ENGINEERS

As a result of continued growth on an international scale, PIPE LINE TECHNOLOGISTS, INC. and affiliated companies will continue to have job opportunities for experienced Pipe Line Engineers.

We have opening at both intermediate and advanced levels in both the United States and foreign locations. Normally, the initial assignment of new staff members is in our Houston headquarters with the possibility of recurring short or long term assignments in other parts of the United States and foreign countries.

Resumes, which will be kept strictly confidential, are invited from graduate engineers with experience in responsible capacities in hydraulic and mechanical design of pipe lines and pipe line facilities, including pump stations, compressor stations and terminals. Experience in estimating and economic studies also desirable. Openings also are expected for experienced construction engineers capable of being assigned as Project Engineers.

These are unusual opportunities for well-qualified men who want to work in an atmosphere where the individual can have an important impact on the overall picture by the competent handling of challenging and out-of-the-ordinary job assignments.

Salaries commensurate with training and work experience. Liberal, well-balanced employee benefit plans.

Please include in resume full particulars regarding education, experience and salary requirements. Arrangements will be made for individual interview with interested and qualified persons.

Pipe Line Technologists, Inc.

3431 West Alabama P. O. Box 22146
Houston 27, Texas

Parker Seal Company Names George Meyer Vice President

George Meyer has been named vice president-manufacturing for Parker Seal Company. He has been named manager of manufacturing and is responsible for all company's manufacturing facilities in Culver City and East Los Angeles, and Berea and Lexington, Ky.

George Meyer

Meyer will transfer headquarters from Culver City to Berea. He has been with the company since 1959. Previously he was associated with Warner & Swasey, Inc., for 12 years. Joe Nenzell will continue as manager of western manufacturing and Earl Hobein will remain as manager of eastern manufacturing.

Grove Valve & Regulator Names Two Sales Engineers

Len E. Brock has been appointed regulator sales and service engineer for the Permian Basin area and Robert Churnside has joined the company as a sales engineer.

Brock had been with Burt Tank Separator and Oil Treating Corporation and has over 15 years experience in the industry. Churnside had been with the F. H. Maloney Company.

Fraser Named Sales Promotion Manager of Continental-Emsco

Tom H. Fraser has been named sales promotion manager of Continental-Emsco Company. Formerly manager of production, Equipment Department, he has been with the company since 1934.

He will be in charge of sales promotion activities for all Continental-Emsco operations, domestic and export.

Hupp Aviation Appoints Plume Chief "Electrodyne" Engineer

William F. Plume has been appointed chief "Electrodyne" engineer for Hupp Aviation Division, Hupp Corporation. Electrodyne valve operators are electro-mechanical units used in pipe line and petroleum industry.

Plume joined the company in 1959 as project engineer.

FLEET-LINE®

WELDING FITTINGS

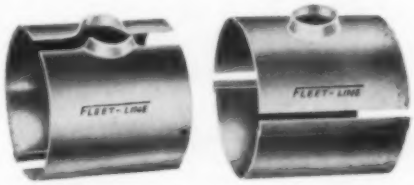
•

LITERATURE BY AIR MAIL... ...ask for it now.

REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.

SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

Full encirclement saddles.



REDUCING TEES, Forged Steel Manifold Type.

Dealers and Stocking Distributors throughout the United States and Canada.

All orders acknowledged by air mail or long distance telephone and filled at once.

STEEL FORGINGS, Inc.

P. O. Box 276K • Shreveport, La.

What's New in EQUIPMENT

Bucket Backfiller

A one-man, foot-steering bucket backfiller, the Superior 150-B, which mounts on International TD-15 and can be used on big inch pipe lines, has been introduced by Superior Equipment Company.

The unit has the mobility for fast clean-up of spoil banks and rapid location changes. It has 12 speeds forward and reverse, from ⅛ to 7.1 mph. New positive clutches run in oil; control boards are hydraulically actuated. High boom clearance permits the in-haul cable of the 150-B to come in above the crawler's tracks, precluding the possibility of the cable's dragging through the mud. Counterweighting is dispensed with by mounting drawworks on the right-hand side.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Separators

A vortex separator for small gas lines has been introduced by J. H. Carruthers & Co., Ltd. The vanes on vaneplate are specially designed to suit each individual application so that there are no moving parts.

Pressures up to 150 psi are handled with cast iron; to 500 psi with cast steel; to 1,500 psi with cast alloy and above that with special steels. For corrosive duties and other special applications materials can be specified by the customer.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

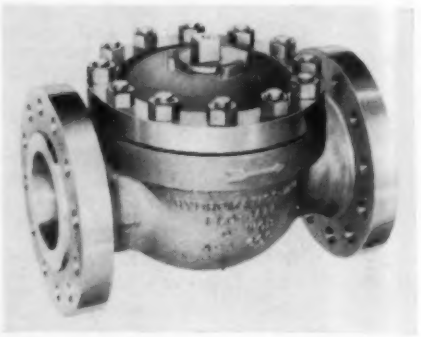
Vapor Inverter

Fumes and gases vented from the storage tank, as product is pumped in, are directed into the air by a new vapor inverter introduced by Johnston & Jennings Co. The unit mounts on the pressure relief vent of a storage tank and protects personnel working on surrounding tank roofs and nearby ground areas from exposure to poisonous fumes.

Inverters do not impair flow capacity of relief vents on which they are used and

are designed and tested for efficient operation even under snow and freezing conditions. They diffuse snow and the bottom holes facilitate rapid drainage of water. Inverters are available in sizes from 2 through 12 inches.

To get a copy, circle **No. E3** on Readers' Service Card, last page this issue.



Flo-Ball Automatic Valve

Automatic flo-ball valves which will allow product separators to pass through them and can be controlled remotely have been announced by Hydromatics, Inc.

They will close upon signal from a remote location to a pressure actuator; safety shut down valves will lock in a maximum of 750 psi. For maintenance, removal of the nuts holding down the top flange, easy access is gained to the ball and seat without removing the valve from the line.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

Crawler Backhoe

A new one-half-yard struck capacity Model 480-crawler backhoe has been introduced by Hydraulic Machinery Company. Powered by a 70 hp, six cylinder gasoline engine, the Model 480 has a 360-degree swing, digging depth of 15 feet, reach of 23 feet and a dump height (closed) of 12 feet, 6 inches.

A three-pump hydraulic system enables operator to work both boom and bucket while swinging. Boom, bucket and dipper stick motion are controlled through 6 double-acting hydraulic cylinders operating at 1,500-psi.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Charger-Battery

A charger-battery combination to provide standby engine starting is available from C&D Batteries, Division of The Electric Autolite Co. The combination is a Slyver-Clad battery with lead calcium plates and an AutoReg silicon rectifier charger designed as a companion to the

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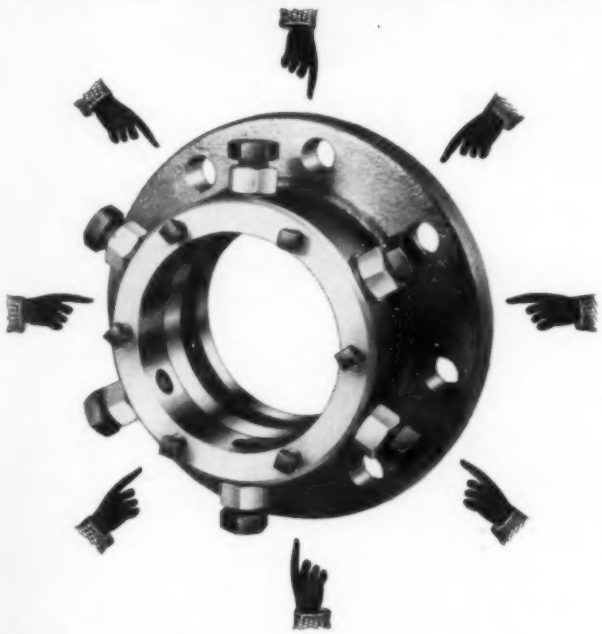
...NO OTHER PIPE FITTING DOES SO MANY JOBS SO WELL



Designed for fast, easy installation plus economy

Plidcoflange applications are practically limitless. This versatile pipe fitting may be welded permanently to the pipeline, without shutting down, or bolted in place for future removal.

Plidcoflange slips over end of pipe, mates up with standard flange facings. No flange spreaders, jacks or bars required. Ideal for use as a blind plate flange. Just slide Plidcoflange back to change plates.

Plidcoflanges are available in standard sizes 2″ through 12″ with 150 lb. A.S.A. steel flanges. Other sizes and pressure classes on request. Send for illustrated brochure.

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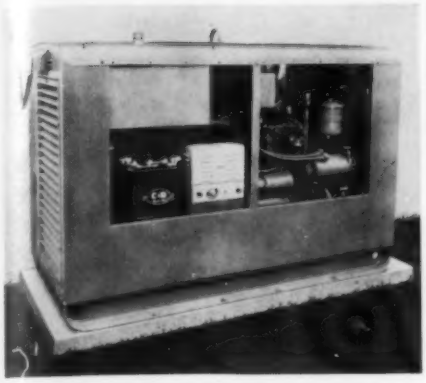

battery. This produces instantaneous starting current for standby gasoline or diesel engines.

The battery is designed to take water only once a year. Heart of the charger is a hermetically sealed silicon rectifier. There are no aging taps and no relays to adjust; trained personnel are not required for operation.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Backfiller

For fast, low-cost backfilling, Vermeer Manufacturing Company has introduced the Pow-R-Ditch filler which deposits dirt back in the ditch in one continuous pass. The unit is powered by a 36-hp Wisconsin engine. Hydraulic power provides forward travel speed during backfilling.

The backfilling unit is a front mounted 24-inch power-driven auger, 7½ feet long. The operator's platform is located above the auger, allowing clear unobstructed visibility both ahead and behind the unit.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.

High Strength Steel

Two new columbium bearing high strength alloy steels, Armco High Strength No. 6 and No. 7, having minimum yield points of 50,000 and 45,000 psi, respectively, have been announced by Armco Steel Corporation. Grades are available as plates, hot-rolled sheets and hot-rolled strip. Formability characteristics of the new grades permit simple bending across the rolling direction, flanging and light forming operations of the type regularly performed on standard commercial quality sheet and plate. Hot rolled products of both grades can be supplied in the pickled condition if desired.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

These two styles of Allpax Packing cover a wide range of applications and many different uses, consistent with the policy of our company—fewer packings for more services.

Both are compounded of the highest quality materials, and between them they cover against such service conditions as steam, water, air, ammonia, gases, oils, distillates, dowtherm, etc. They are for use on centrifugal and rotary pumps, valve stems, expansion joints and similar equipment.

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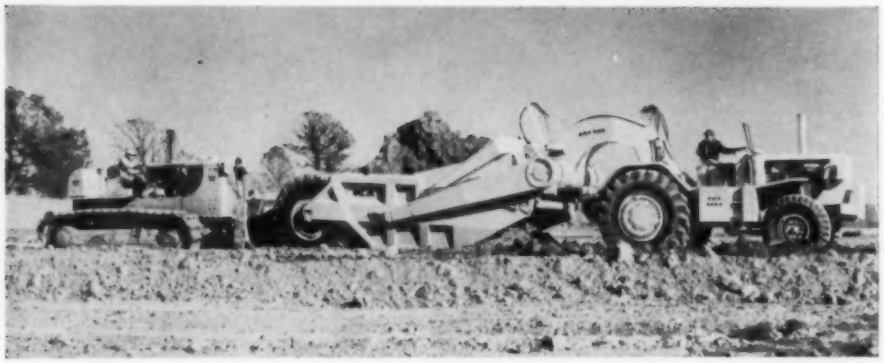


Tractor-Scrapers

Caterpillar Tractor Company announces two new 420-maximum horsepower wheel tractor-scrapers that feature torque divider-power shift transmission. A four-valve-in-head diesel engine with a maximum rating of 420 hp and flywheel rating of 335 hp, is the power source for the units. The 630A has top speed of 41 mph and 631A, 31 mph.

Scrapers are of lowbowl design and have struck capacity of 21 cubic yards with a heaped capacity of 28 cubic yards. For extra-large production capabilities, a new unit, 630A-482C tractor scraper combination will be available. This model has a 35-cubic yard heaped capacity and 28-struck capacity. For shifting, operator moves the selector lever to one of three speed range positions. Within each range, the most appropriate of three drives is automatically selected to meet changing power requirements. Three drives are: torque divider drive, direct drive and overdrive. A dash-mounted indicator shows the operator when to shift to the next higher speed range.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

Polyethylene Pipe

Glamorgan Pipe and Foundry Company announces a new pipe made of high density linear polyethylene resin manufactured by Phillips Chemical Company. It is produced in sizes from one-half-inch through 4-inch and designed for low and medium-pressure applications.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Battery Control Units

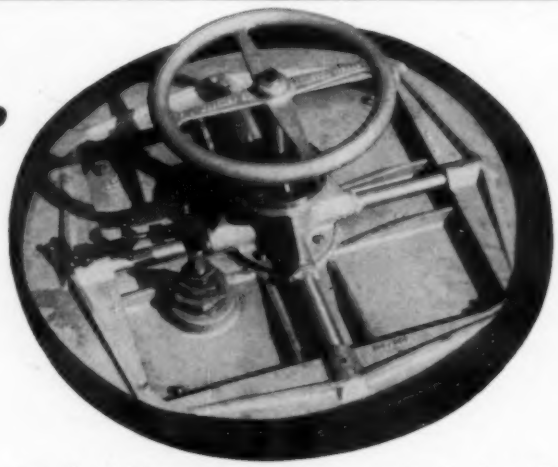
The lives of lead-acid and nickel-cadmium stationary batteries can be lengthened by coupling a new automatic control unit with Exide Industrial Marketing Division's new two-rate battery chargers.

Eliminating any need for manual adjustments except for routine maintenance, the new unit varies the charge rate of the rectifier as required by the battery and prevents overcharge or undercharge. The control unit is designed as a mate for economical, versatile Exide Hi-Lo Charger models used with batteries such as those that supply stand-by and intermittent power for various operations.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

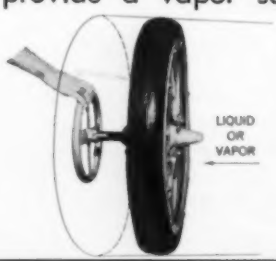
Finally....

A PRACTICAL PIPE LINE END PLUG



The Maloney Pipe Line End Plug is a rugged, light weight unit for positive sealing of Pipe Lines during repairs or construction. Designed to eliminate air entering or liquid/gas draining from the line, the Maloney Pipe Line End Plug will provide a vapor seal on pipe of **any** wall thickness in the nominal size for which designed.

Rugged aluminum body, with a specially designed sealing rubber, is light weight. Even the "Big Inch" sizes are a one-man installation. Merely slide the unit in the line and lock tight with the hand wheel.



Equipped with a vent for safe "breathing" action. Available in all sizes from 14 inch through 36 inch.

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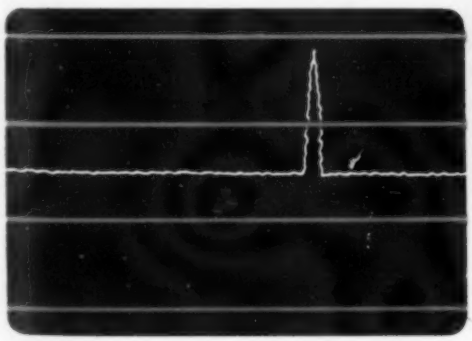

Long-lasting trouble-free quality is the goal toward which this basic steel producer continuously directs every pipe making skill and facility. Acme-Newport's complete control begins in the furnace and continues through every process. Even to final checking of finished pipe by the new electronic eye, which scans the entire surface for any imperfection that may have escaped every other safeguard. All this care in the production of electric weld line pipe makes Acme-Newport your logical source for 4″ and 6″ sizes, standard and thin wall.

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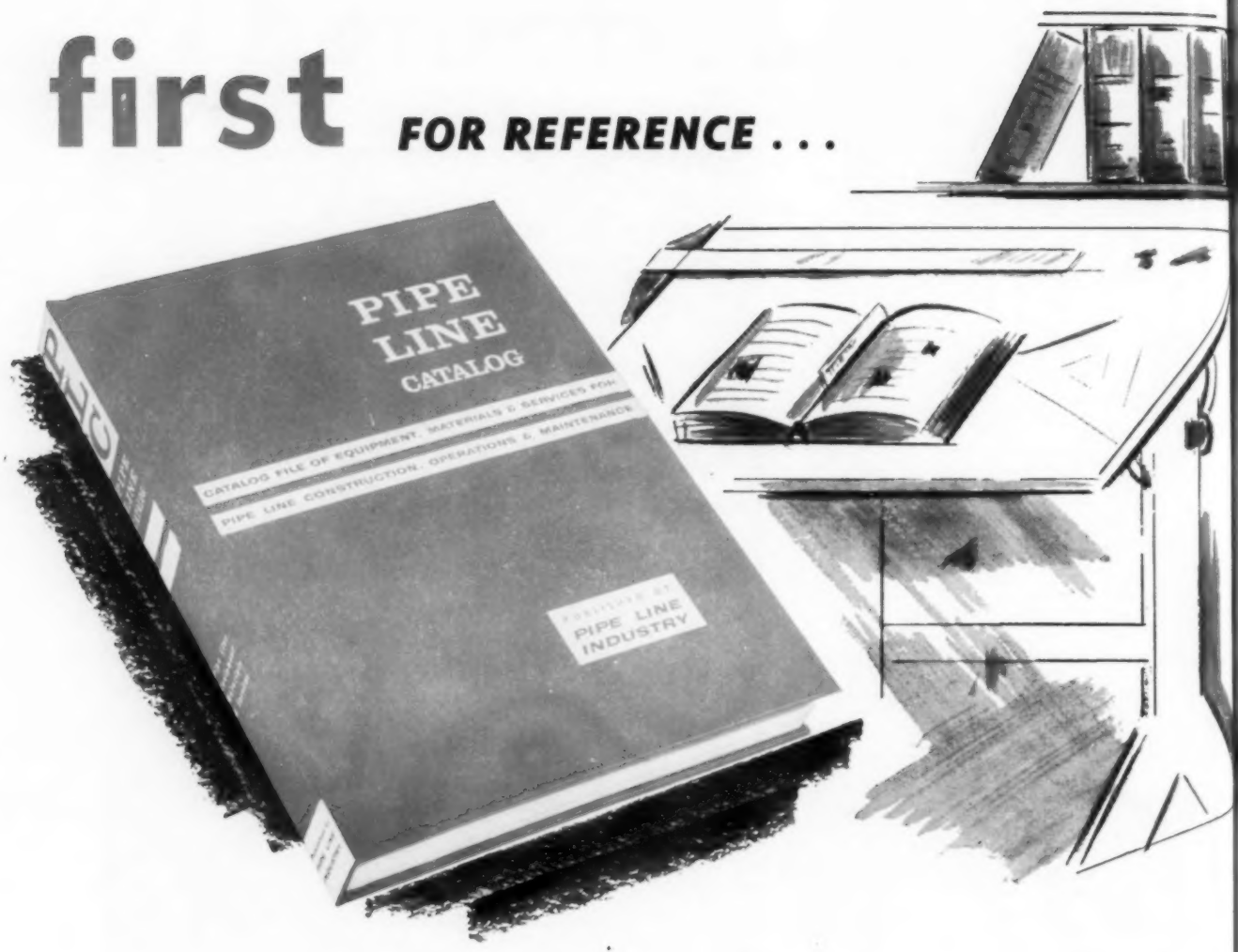

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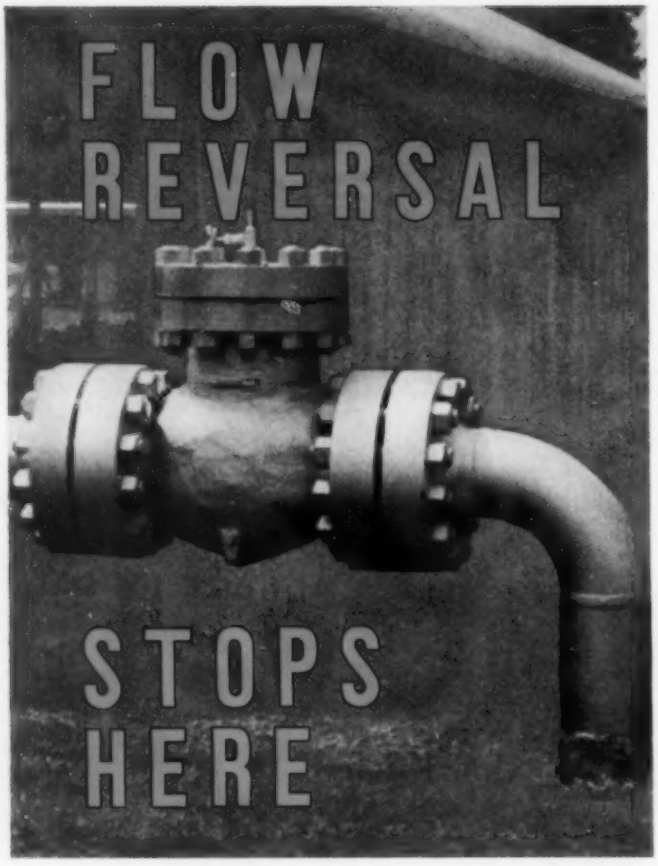

Line back-surge is prevented by a positive, non-slam shut-off of the Daniel piston-controlled check valve. The "floating" piston rides well above the valve seat with line surges, eliminating chatter. Safely handles compressor and pump discharges, steam, gas and vapor flows.

A.S.A. pipeline, refinery and general use valves, 1″ - 16″, up to 6,000 p.s.i.g.

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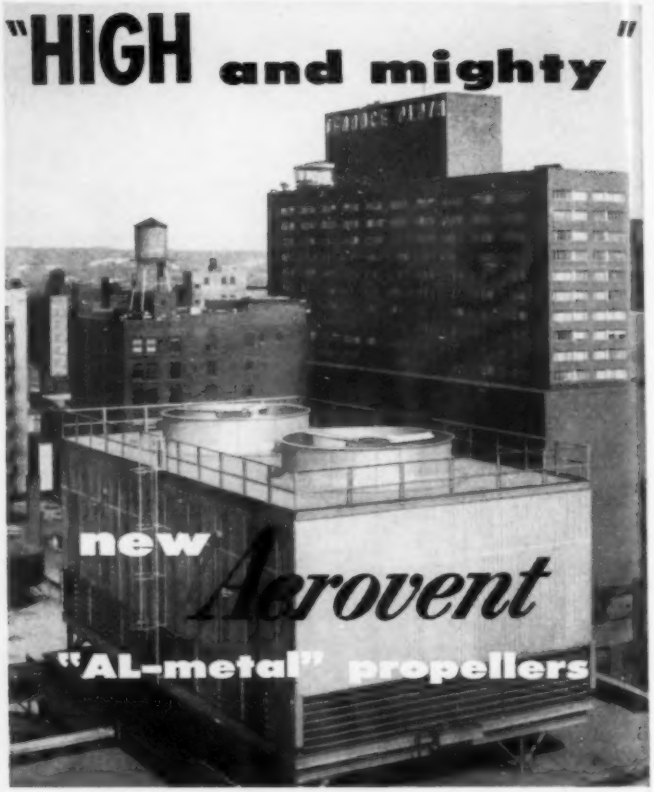

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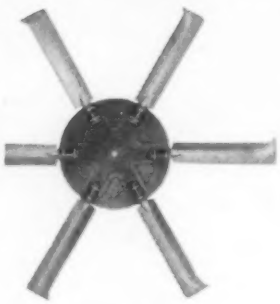

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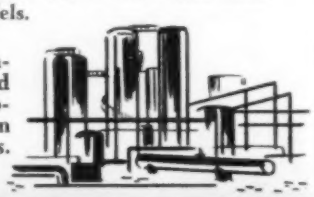

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Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Regulators

A 12-page bulletin has been published by Rockwell Manufacturing Company describing the 1001 regulators for gas industry. The regulators provide accurate control for installations requiring both large and small flow rates where supply pressures ranging up to 200 psi must be reduced to 60 psi or less. The three-color bulletin is highly illustrated and includes information on where the regulators are used, how they are made, how to install them and how to inspect and service them.

To get a copy, circle **No. E12** on Readers' Service Card, last page this issue.

Safety Control

Amot Controls Corporation has issued a 4-page brochure describing Amot Model 2800A safety control for low cost protection of diesel, gas or gasoline engines. It is a mechanical unit used to guard against operation under excessively high water temperature or low pressure.

The brochure illustrates and describes the Model 2800A, what it does, how it is installed and how it operates. It is complete with diagrams showing four variations of installation, dependent upon desired function in connection with shutdown mechanism.

To get a copy, circle **No. E13** on Readers' Service Card, last page this issue.

Crawler Tractors

Allis-Chalmers Manufacturing Company announces a new 8-page brochure on its industrial crawler tractors H-3 and HD-3.

Also included is illustrated information covering engineering, design and construction features of the recently introduced compact crawlers along with data on gasoline or diesel power plants.

To get a copy, circle **No. E14** on Readers' Service Card, last page this issue.

Generating Systems

A new bulletin on a complete line of engine-driven electrical generating systems in the range of 10 to 200 kilowatts is available from Consolidated Diesel Electric Corporation.

The catalog includes the firm's uninterrupted power supply for critical applications where even a few seconds interruption in electrical power cannot be tolerated. Other products featured are adverse environmental power units and an automatic positive power system. Diesel generators are available from 10 to 200 kilowatts for use either as primary sources of electrical power or as standby emergency power supplies.

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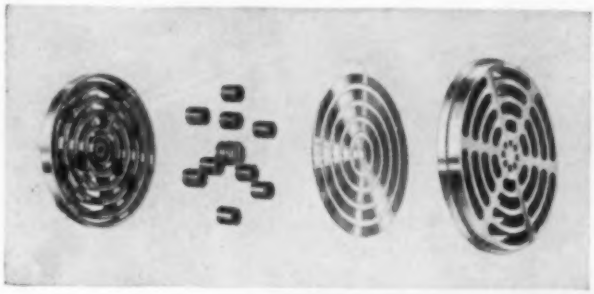

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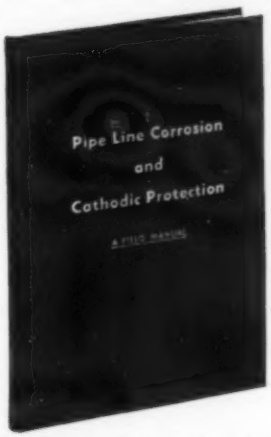

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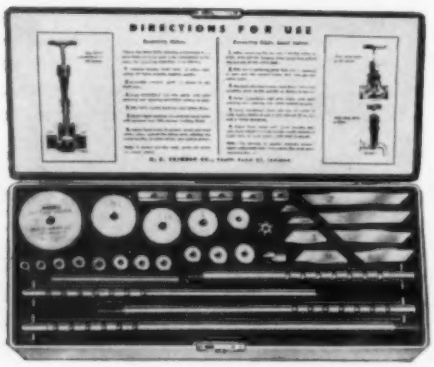

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Cutters operating under screw feed, leave worn, scored seats glass-smooth, level, absolutely accurate and tight.

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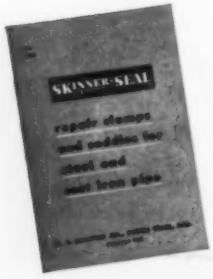

FREE catalog showing our pipe repair clamps, saddles, and reseating tools

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

Sprockets

Features of Caterpillar Tractor Co. sprockets are described in an eight-page booklet. "Sprockets by Caterpillar" is a highly illustrated two-color booklet.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

Heat Exchangers

Young Radiator Company has issued a 15-page, 2-color catalog on revised shell and tube heat exchangers. It covers complete data on copper base alloy, steel and stainless steel fixed tube bundle heat exchangers. It includes single-pass, two-pass, and four-pass models for cooling water and oil in fresh or salt water applications as well as specially engineered heat exchangers for heating or cooling liquids or gases.

Catalog lists tables showing pressure ratings and material specifications for steam service heat exchangers. Construction features, model identification and a 6-step set of instructions explain the selection of heat exchangers.

For more data, circle **No. E17** on Readers' Service Card, last page this issue.

Aluminum Grilles

A new Anotec architectural anodized aluminum grilles specification manual has been published by Klemp International. The manual provides complete product specifications on the wide choice of standard geometric patterns, dimensions and colors. Industrial, commercial and housing design use, in new construction and modernization are shown. Construction details of different applications are fully illustrated with technical drawings.

For more data, circle **No. E18** on Readers' Service Card, last page this issue.

Yoloy Steel Pipe

Youngstown Sheet and Tube Company has prepared a brochure including data on corrosion resistant qualities and physical features of Yoloy steel pipe. Yoloy is available in continuous weld and seamless standard and extra strong pipe sizes, and is a copper-nickel, high strength, low-alloy steel proved in 25 years of use. The 8-page brochure is illustrated with photos of Yoloy pipe installations and charts and graphs.

For more data, circle **No. E19** on Readers' Service Card, last page this issue.

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• Dot preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current (1960-61) third revision of The Pipe Line Catalog.

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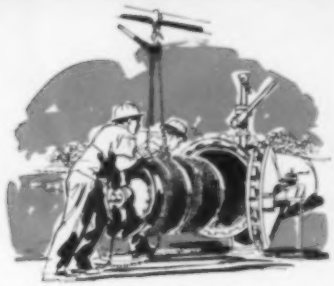
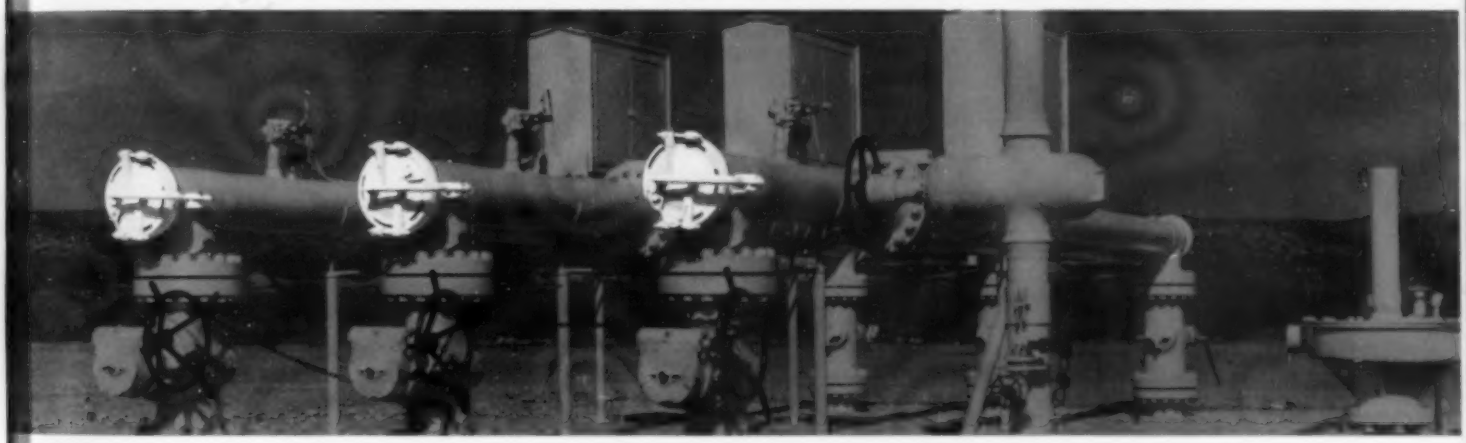
Read "between the pipelines"



UNIBOLT Hinged Closures started a new trend in pipeline scraper traps . . . greatly simplified the sending and receiving of pigs. Release only two bolts and this closure swings open and shut on a sturdy hinge. The self-sealing resilient gasket seldom, if ever, needs replacing.



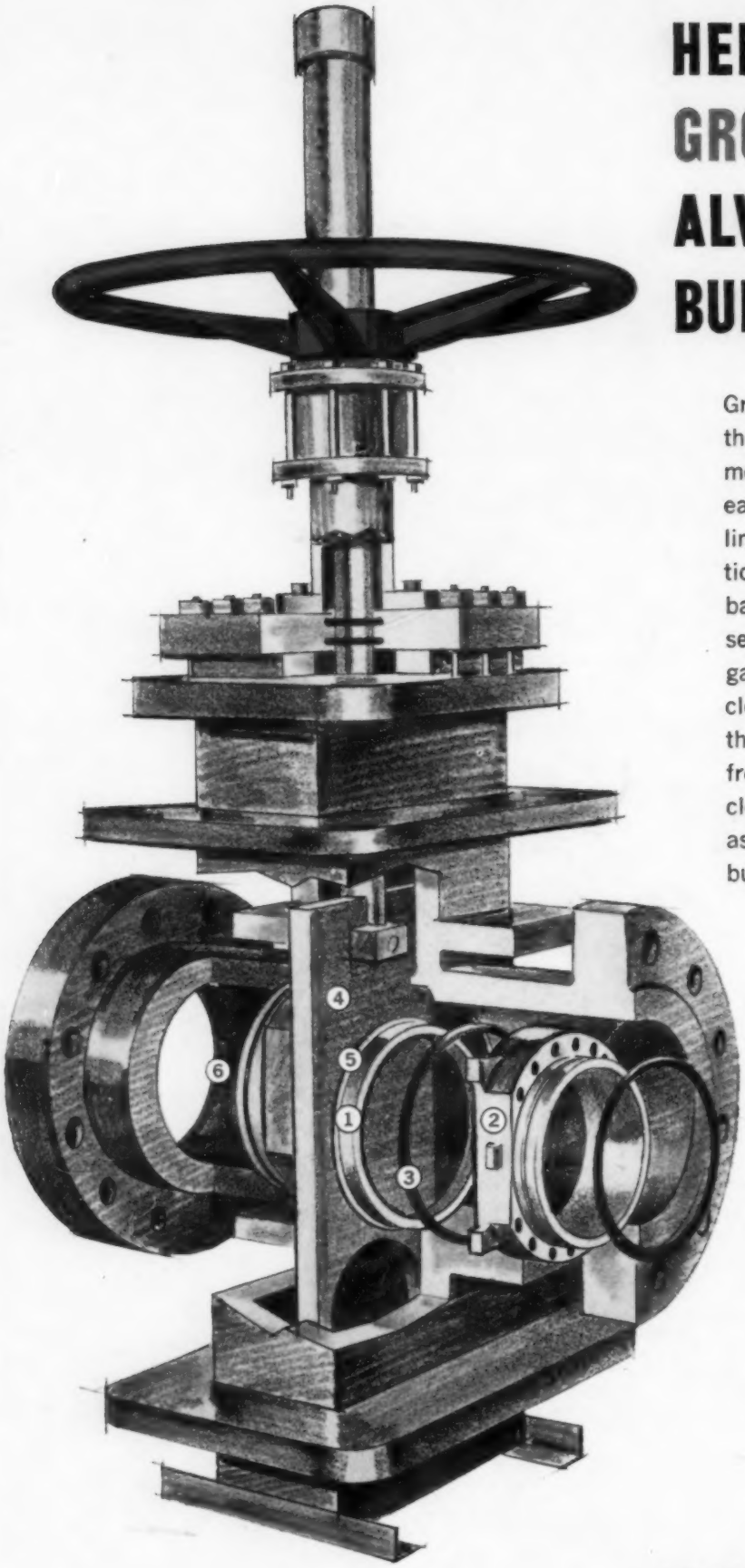
These are UNIBOLT Hinged Closures on a gas pipeline meter manifold. They permit easy access to the meter runs for inspection and cleaning.

(Left) Gas pipeline blowoff head equipped with UNIBOLT Closures on a cantilever hinge for easy opening. A bleeder plug is provided for safely relieving pressure that may leak thru the riser valve. (Right) UNIBOLT Welding Neck Couplings in a products pipeline manifold. The cross-overs are equipped with a half-coupling which interchanges with blanking plugs on the risers. This arrangement eliminates many valves and insures against commingling of products.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas



HERE'S WHY A GROVE G-4 VALVE ALWAYS GIVES A BUBBLE-TIGHT SEAL

Grove protected Seal-"O"-Ring® system is the heart of the G-4. Inner (1) and outer (2) metal seat rings shield the o-rings (3) on each side of the gate (4) from damage by line contaminates. Inner seat rings also function as a primary metal-to-metal seal (5) backed up by the o-rings. No lubricants or sealing compounds are needed. The floating gate and seats assure fast, easy opening and closing, and positive, bubble-tight sealing; the inner metal rings scrape foreign matter from the gate while the o-rings squeegee it clean. Through conduit (6) is provided to assure ideal flow characteristics. Send for bulletin #571.

GROVE PIPELINE VALVES

GROVE VALVE AND REGULATOR COMPANY

a subsidiary of Walworth

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Offices throughout the U.S. and in Western Canada